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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ON SOME RESEMBLANCES OF CROWN-GALL TO HUMAN CANCER¹

THE disease on which I shall speak to-day is known in this country as crown-gall, because it has been observed most frequently on the crowns of trees and shrubs, but it is not peculiar to this situation. It occurs also on roots and shoots. This disease has been known to cultivators and to plant pathologists for many years and has caused more or less injury to a variety of plants both in this country and in Europe. Of plants subject to serious injury may be mentioned: Roses, almonds, peaches, raspberries, grapes. Sometimes the plants are only dwarfed or crippled, at other times killed. Recovery, especially in certain species, is frequent. In Italy the attacked grape vines are said to live about four years.

It has been ascribed to a variety of causes, *e. g.*, frosts, wounds made in cultivating, insect injuries, fungous injuries, physiological disturbances, etc. The actual cause was not known until discovered by the writer and his associates. Team work on this disease has been carried on in the U. S. Department of Agriculture for the last eight years, *i. e.*, since February, 1904. The first successful pure culture inoculations were obtained in 1906. The organism was described and named by us in 1907.²

¹ Address as retiring president of the Botanical Society of America, Washington, D. C., December 28, 1911. By invitation members of the following organizations were also present: Section G, of the American Association for the Advancement of Science; Society of American Bacteriologists, and the American Phytopathological Society.

² SCIENCE, N. S., Vol. XXV., No. 643, pp. 671-673, 1907; see also *Centralb. f. Bakt.*, 2 Abt., XX. Bd.

Addresses setting forth the parasitic nature of the organism have been given before this Society by Dr. Townsend, and before the Society of American Bacteriologists and the American Phytopathological Society by myself.³ I have also twice in public addresses before the American Association for Cancer Research called attention to certain general resemblances of this disease to malignant human tumors, namely, at the Boston meeting in December, 1909 (lantern-slide address), and again in the spring of 1910 at the Washington meeting of the Association, where I showed specimens of the disease. The whole subject so far as regards the etiology of the disease was also summed up in a big bulletin published by the Bureau of Plant Industry, U. S. Department of Agriculture, early in 1911.⁴ I may assume, therefore, that this audience is fairly well acquainted with the evidence adduced by us to prove the pathogenic nature of the organism we have called *Bacterium tumefaciens*, and therefore I shall not spend any time on this phase of the subject. Those who are not familiar with the evidence can easily obtain the necessary publications and if these are not convincing they may repeat the experiments.

In a brief way I have also published on the newer discoveries upon which I am to speak to-day, *i. e.*, in a third address before the American Association for Cancer Research,⁵ an abstract of which was published by the Department of Agriculture as Circular No. 85, Bureau of Plant Industry, and in *Zeitschrift f. Krebsforschung*,

³ Vide SCIENCE, February 12, 1909, p. 273; *ibid.*, August 13, 1909, p. 223; and *Phytopathology*, 1911, Vol. I., p. 7.

⁴ No. 213, "Crown-Gall of Plants: Its Cause and Remedy." To be had from the Superintendent of Documents, Government Printing Office, Washington, D. C. Price 40 cents.

⁵ Buffalo, April 13, 1911.

11 Bd., 1 Heft. Since that date the subject has been studied continuously. Numerous sections have been prepared, and I will show you lantern slides of photomicrographs made from some of these sections, so that you will be able to judge for yourselves as to the bearing of the evidence.

It is hardly possible to say who first noted the superficial resemblance of overgrowths on plants to animal tumors. It probably goes far back of published records, since we have in English the word "canker" applied to certain of these overgrowths, which word is only another form of the word cancer. Also in German, the word "Krebs" is applied indifferently to these overgrowths and to malignant human tumors. It is one thing, however, to find a superficial resemblance of plant diseases to animal diseases, and quite another to establish any strict analogy. In fact, as histological studies on cancer have multiplied animal pathologists have been more and more convinced that there is no real likeness between the plant overgrowths and malignant animal tumors, and this is true enough, I believe, for club-root of cabbage, the plant disease most studied in this connection. A comparatively recent statement by Alfred Fischer that the only thing they have in common is the name (Krebs) may be taken as fairly representing the current view.⁶ I shall hope, however, to show you before I am through that they have a good deal in common, so much, in fact, that I believe we have in these particular plant overgrowths a key to unlock the whole cancer situation. In consideration of these discoveries many closed doors in cancer research must now be opened and studies on the etiology of the disease must be done over with a view to finding a parasite within the cancer cell, and separating

⁶ *Vorlesungen ueber Bakterien*, 2te Auflage, 1903, p. 277.

it therefrom by an improved technic of isolation. Before I show you any slides or describe further the discoveries made it will be necessary for me to refer briefly to the nature of cancer and certain other malignant animal diseases.

When I first called attention of members of the American Association for Cancer Research to crown-gall in 1909, the reply of some of the members was that while I had demonstrated crown-gall to be a very interesting disease it was evidently a granuloma, and not a true tumor. With this conclusion I can not agree. That you may understand why crown-galls are not granulomata I wish briefly to call your attention to the phenomena occurring in such diseases. As example of a granuloma, we may take tuberculosis. We have in this disease a focus of infection and source of irritation in the presence of a microorganism. Against this organism the body reacts with the formation in the immediately surrounding tissues of cell growths not unlike those which occur in the bottom and sides of wounds, namely, granulation tissue, hence the name granuloma. In this manner nodular growths arise, but these nodular growths are limited in extent of tissue involved, are produced from the tissues immediately surrounding the bacterial nest, are not vascularized, and soon become disorganized in their interior. In tuberculosis the blood vessels occurring naturally within the attacked area are obliterated and excluded from the tubercle; in certain other granulomata, *e. g.*, syphilitic gummata, the vessels are not obliterated, but they are distinct in other ways, *e. g.*, enclosed in a fibrous capsule. The disease is carried from place to place within the body by the migration of the microorganisms, either in the blood stream or the lymphatics or in some other way, *e. g.*, through the digestive tract. Wherever

these migratory organisms lodge they set up or may set up similar irritations with the production of similar nodules of granular tissue, the same being an effort on the part of the infected animal to overcome the disease. The point which I wish specially to emphasize is the fact that in these secondary infections the granular tissue which develops is formed out of the particular organ in which the parasites happen to lodge, and does not consist of cells brought to it from a distance.

In this respect cancers are quite different. Parenthetically I might stop here long enough to say that I shall for the purposes of this address use the term cancer in a loose, general sense for all malignant human tumors. First, because the crown-gall which I have studied seems to partake of the nature of different types of malignant animal tumors, and because I believe that when the cause of malignant animal tumors is discovered we shall find that many of the hard and fast lines of separation which the animal histologists have erected between sarcoma, carcinoma, etc., will be found untenable.

In cancer we have an enormous multiplication of certain tissues of the animal (epithelial, connective, etc.) which by continued growth crush and disorganize the surrounding tissues. These growths are more or less highly vascularized, and new vessels are formed as the tumor develops, but not to an extent sufficient to carry on the growth beyond a certain point. Usually there is a great excess of parenchyma cells in such a tumor and the blood vessels are not sufficiently numerous to nourish it properly, so that after a longer or shorter period (months or years) portions of it disorganize often into open wounds which are then readily infected by all sorts of secondary organisms with all the well-known disastrous results. This then is one strik-

ing difference between granulomata and cancers, but the true nature of the cancerous development becomes more evident in the secondary tumors. The mere fact that a primary cancer has developed on some part of the body does not constitute the chief danger, since one might have such a tumor for a long time without death supervening, unless the primary growth happened to be situated in or near a vital organ. What constitutes the peculiar malignancy of cancer is the tendency to form secondary growths in various parts of the body, including the vital organs, and it is this clearly recognized danger which in modern times has led to the universal recommendation on the part of competent physicians and surgeons of the early extirpation of suspicious growths, the hope being that the surgeon may be able to dissect out all the infected tissues and thus free the patient from the disease. This is the reason why, for instance, in cancer of the breast the surgeon so carefully removes not only the infected breast, but the lymphatics for long distances away, that he may, if possible, reach beyond the unseen growing cancer strands. This also is why delayed operations for cancer are seldom successful.

In case of granulomata, as we have seen, it is the parasite which migrates. In case of cancers it is the cancer cell itself which migrates, *i. e.*, some of the body cells which under some unknown stimulation have been taken out of the physiological control of the body and have become thus, as it were, parasites on their fellow cells. There are two ways in which secondary tumors are derived from the primary tumor in cancer: (1) The primary tumor growing peripherally sends out roots or strands which bore their way through normal tissues of the body, sometimes for long distances, developing from certain

portions of these strands secondary tumors.

(2) Small groups of cancer cells are dislodged from the parent tumor and carried as floating islands in the blood stream or lymphatics to develop secondary tumors where they lodge. The first of these ways has been definitely established by observation; the second by inference, no connecting strand having been discovered. Naturally these secondary tumors, being derived from the primary tumor, tend to partake of the nature of the tissue from which the primary tumor has developed. For example, if the primary tumor be in the stomach, the secondary tumors are likely to contain glandular cells resembling those of the stomach, wherever they may be developed. This is such a striking peculiarity that it is often possible for the animal pathologist to tell from the study of his sections whether the cancer is primary or secondary, and, if secondary, in what organ the primary tumor is located. In case of tumors located in an organ containing all three of the embryonic layers or developed out of cell-rests of this nature we might have in the tumors a jumbled-up mass of all sorts of tissues—skin, bone, teeth, hair, muscle, nerve, etc. This at least is one method of explaining the embryomata.

Having found no parasite in the cancer cells, a majority of the animal pathologists have given up the idea that cancer can be of parasitic origin. For a generation the research workers fell back upon Cohnheim's hypothesis that cancers were due to the development of small fragments of tissue cut off from the parent layer during embryonal growth, to be enclosed in other tissues and lie dormant until acted on abnormally later in life by some unknown stimulus. But while studies of the animal body show that such separation of small portions of tissue from the germinal layer is not uncommon, research workers on

cancer are now generally agreed, I believe, that there are many phenomena connected with the development of cancer for which this hypothesis of Cohnheim offers a wholly inadequate explanation. Moreover, what induces these dormant cells to develop was never determined. A very favorite theory with cancer specialists has been that the cancer cell itself is the only parasite, and that no infections could be obtained on animals unless the living cancer cell were present. This hypothesis must now be abandoned owing to the discovery by Peyton Rous (1911) that sarcoma of chickens may be produced in the absence of cancer cells, *i. e.*, by cancerous fluid filtered free from all traces of living cancer cells. So far as I know he has not expressed any opinion as to the nature of the infection which has been separated from his ground chicken sarcomata by centrifuging and also by filtration through Berkefeld bougies, but in the light of the evidence we have secured from plants I believe you will agree with me that it can be nothing else than a living microorganism, minute enough to pass through the walls of the rather coarse filter.

In crown-galls I have not found the second method of formation of secondary tumors, namely, by the detachment of small fragments of the primary tumor to be carried in a stream and lodged at a distance. This method we should hardly expect to find in plants, owing to the fact that there is no rapid blood stream such as we find in animals, neither does it seem to be more than an epiphenomenon in tumor growth, the essential thing being the abnormal internal stimulus to cell division. The first method of propagation, namely, by strands, occurs, however, and parallels to my mind very strictly what occurs in malignant animal tumors, *e. g.*, in carcinoma, sarcoma, etc.

The existence of the tumor strand in crown-gall was overlooked for a long time. But last spring in making some sections of Paris daisy plants which had been inoculated with the crown-gall organism and bore both primary and secondary galls, I saw on cross-section a tumor-strand in the inner wood next to the pith between the secondary and the primary tumor and near the latter. This was about a millimeter in diameter and of a different color, *i. e.*, greenish, and easily observed by any one. Often, however, this strand is composed of a few cells only and difficult to find, even with the compound microscope. This, together with preoccupation on other phases of the research, must serve to explain why it was overlooked for so long a time. As soon as I saw this parenchyma out of place I said, "Here is a tumor strand!" and began to examine many other plants to see if it was at all constant—finding it visible to the naked eye near the primary tumor in perhaps 20 per cent. of the plants examined. The question then arose whether it was merely local, or could be traced for some distance and was of constant occurrence in the normal tissue between the primary and the secondary tumors. Since then many inoculated plants have been examined microscopically, and in all of them I have been able to find this tumor strand, although, as already stated, in many cases it is composed of a very few cells. In the Paris daisy it usually bores its way between pith and wood, or at the inner edge of the wood wedge in the protoxylem, apparently along lines of least resistance. (Lantern slides were exhibited, showing cross and longitudinal sections of such strands from the inoculated plants.)

On this strand are developed secondary tumors, apparently either where the food supply is most abundant or where the pressure of surrounding tissues is least,

yet possibly other factors are involved. Frequently the growth of the strand is rapid. In very juicy favorable material in 16 days from the date of the primary inoculation I have seen secondary tumors develop from such strands at a distance of 10 centimeters from the parent tumor. Often deep in the resistant wood the tumor strand is under great pressure. In softer parts the overlying tissues are split open, and the deep secondary tumor then comes to the surface. In the Paris daisy, when the primary tumor is on the stem, secondary tumors often develop on the leaves, and strands of tumor tissue have been traced in numerous instances all the way from the primary tumors through the stem into the leaf, and all stages of the development of the secondary tumors observed on many plants. This tumor strand boring its way through stems and leaves appears to be as much a foreign body as the roots of a mistletoe or the mycelium of a fungus. From these strands and from these secondary tumors we have isolated the same microorganism that occurs in the primary tumors and with subcultures from such bacterial colonies have reproduced the disease. The discovery of this strand affords a satisfactory explanation for the fact that the morbid growth usually returns after excision.

The second striking fact to which I wish to call your attention is that when the primary tumor occurs in the stem and the secondary tumor in the leaf the structure of the secondary tumor is not that of the leaf in which it is growing, but of the stem from which the strand was derived. If the discovery of the strand was an accident, this latter discovery was reasoned out, knowing what takes place in cancer. I said immediately, if this is a tumor-strand we ought to find a stem-structure in the leaf tumors, and the very first leaf tumors

cut showed typical examples of it. In secondary tumors occurring in the leaves as the result of stem inoculations the development of a stem consisting of a loose, rapidly growing parenchyma in the center, surrounded by wood wedges separated by medullary rays, beyond which is a cambium zone and a bark can be made out very clearly (slides exhibited). Sometimes these secondary tumors develop a very perfect stem structure; often, however, the stem is more or less imperfect with the inclusion of large parenchyma cells of the leaf, and with a great overproduction of stem parenchyma (medullary rays, etc.) as compared with the vascular portion. As this secondary tumor grows the surrounding leaf structure is destroyed, and eventually we may have a growth which bears no resemblance whatever to a leaf. Often, however, fragments of the leaf adhere to the surface of the tumor, and show an unchanged leaf structure.

These secondary leaf-tumors then, so far at least as regards the parenchymatous portion, are composed, in great part at least, of descendants of the originally infected stem-cells. The growth is an invasion of infected cells. To what extent neighboring uninfected cells are also involved is uncertain. The wood always shows hyperplasia, sometimes to a very marked degree in the vicinity of a stem tumor, and usually also in the vicinity of the tumor strand, especially if this is large. Are all of these wood cells infected? Probably not. I see no reason why we might not have changes in the plant distantly comparable to the inflammatory changes which take place in the vicinity of a malignant animal tumor, *i. e.*, an excessive multiplication of cells which while a part of the tumor are not its malignant portion. This must be left for further study.

This astonishing stem structure in leaves

is quite parallel to that which occurs in certain cancers of secondary origin where the structure of the primary tumor is outlined, albeit often only imperfectly. We might now inquire whether primary tumors produced on leaves do not have the same structure as those just described as secondary tumors. We have made needle-puncture inoculations on leaves of Paris daisy and have studied the structure of the tumors which develop and these do not have a stem structure but an irregular epithelioma-like structure derived wholly from the leaf, as may be seen from the lantern slide exhibited.

What happens finally in the case of cancer happens in crown-gall, namely, the tissues not being sufficiently vascularized, and composed of a great excess of soft and fleshy cells, are easily disorganized with the production of open wounds. In case of crown-galls on the daisy and many other fleshy plants after about two or three months large portions of the tumorous tissue decay with the formation of open wounds, subject to a variety of secondary infections.

It should be stated here, however, that in the crown-gall there are no abscess cavities such as we find often in granulomata or in such a disease as olive tuberculosis. Sometimes there is a multiplication of bacteria in the vessels in the vicinity of the needle puncture, but whether these are the crown-gall organisms or not we have not yet determined. Certain it is that when the tumor has begun to grow rapidly no bacteria or other granular matters have been found in the vessels or in the intercellular spaces. The causal bacteria occur inside the cells, which are stimulated by their presence to multiply with great rapidity and without reference to the physiological needs of the plants, *i. e.*, the plant has no direct control over the growth.

In these particulars crown-gall resembles epitheliomatous growths, while in the embryonal character of its luxuriant granulations and in its predilection for young plants and rapidly growing tissues it is more like sarcoma. The growth is a hyperplasia rather than a hypertrophy, although occasional groups of large cells occur. There can be no doubt as to the development of new vessels in the growing tumor. This is shown clearly by the anatomy of the secondary tumors. Whether the vessels are ingrowths from the surrounding tissues, or outgrowths from the tumor strand, or both, as would seem to be the case, must be left for further inquiry. The anatomy is unlike that of club-root of cabbage, where the growth consists of an enormous enlargement of a comparatively few infected cells.

I think, therefore, that we have in crown-galls a striking analogy to what occurs in malignant animal tumors, namely, to recapitulate, *the cell itself a disturbing force*, *i. e.*, an enormous multiplication of certain cells of the body without reference to physiological needs and in opposition to the best interests of the organism; a non-capsulate tumor, with absence of abscess cavities and of plainly visible parasites; peripheral growth and a well-developed stroma consisting of vessels and fibers; from this primary tumor the development of strands of tumor tissue upon which secondary tumors develop; in the secondary tumors a strong tendency to take on the structure of the organ in which the primary tumor has developed; frequent if not necessary origin of the primary tumor in bruises, wounds or irritated places; complete recovery if all the tumor tissue is extirpated, failure if it is not; in some cases spontaneous recovery. The chief difference so far made out is that in case of cancer cells we know nothing whatever as

to the cause of the abnormal growth,⁷ whereas in case of these overgrowths on plants we have definitely proved them to be due to the presence of an intracellular schizomycete which we have many times isolated and reisolated in pure culture and by means of which we can reproduce the disease at will.

The question now arises whether animal tumors might not be produced by means of the crown-gall organism. I might state here that while I believe cancer to be due to some intracellular microorganism which in its physiological peculiarities, action on the cell nucleus, etc., is like the one we have discovered, I do not maintain the overgrowths in warm-blooded animals to be due to this particular organism, for the reason that its maximum temperature for growth (daisy strain) is a little under the blood temperature of such animals. In thinking over the matter it seemed to me not unlikely, however, that with this organism I might be able to produce tumors in cold-blooded animals, and so four years ago I attempted to do it. I will show you only a slide or two made from an inoculated fish. I used for this purpose brook trout and in a very considerable portion of my inoculations I succeeded in producing ulcers in the deeper tissues where the needle entered. In this instance the needle entered the belly wall of the fish. The wound healed externally, but at the end of 21 days when the trout was dissected there was a well defined inner growth (proliferation nodule) in the connective tissue between the muscles with formation of giant cells. There were also when dissected two external sore spots,

"Some unknown force, the essential nature of which has so far completely escaped our knowledge and our comprehension, is capable of calling forth this latent power of proliferation, and the germ [cancer cell] begins to grow out of itself, like a seed that has been buried in the ground." (Dürek.)

one below the pectoral fin and the other below the anal fin, both of recent occurrence, but no throat or gill ulcers in this fish. Similar growths were obtained in the eye-socket. I showed sections cut from one of these ulcers to one of the most distinguished research workers on cancer in this country and he said "if we had this in man we should call it sarcoma." (Slides exhibited.) I propose to repeat and extend the work on trout and therefore will say but little about this phase of the investigation.

In conclusion I wish to call attention to some of the peculiarities of the microorganism (*Bacterium tumefaciens*) as determined by our cultural work. As well known to many of you, we prosecuted our studies upon the crown-gall for two years before we were able to isolate the parasitic organism. Ten years previous to this I spent six months on the subject with a similar negative result. Two obstacles of which we were unaware blocked the way. In the first place the organism in a viable form occurs in the tumor tissue of the daisy in small numbers only. If inoculations are made from crown-gall tissue, using about that amount of tissue we are accustomed to use for other bacterial plant diseases, and also for many animal diseases, the chances are that no colonies of the parasite will be obtained upon the plates. I have no doubt now that we made dozens of plates—yes, I might say dozens of separate sets of poured plate cultures, on which not a single colony of the right sort developed. It was only when we learned to inoculate our bouillons and agar plates with large quantities of the tumor material that we were able to obtain a sprinkling of colonies of the right organism. From a young, rapidly growing tumor it is always possible to obtain the organism with proper technic and sometimes in pure cultures, but

often only by using a hundred, a thousand, or a hundred thousand times too much material, if one were working with other organisms. The second obstacle is the fact that the living bacteria in the tumor tissue occur for the most part in a paralyzed condition, either as involution forms or in some other form which does not grow readily when plates are made. Cultures were made every few weeks from crown-gall tissue for two years and numerous and various bacteria were obtained on these plates, pricked off for sub-culture, studied microscopically and culturally, and inoculated into the plant with negative results, these organisms being the saprophytes which usually accompany crown-gall. The plates were usually discarded after three or four days, and so the work went on. If, however, one inoculates copiously as described, and waits a week or ten days for the paralyzed organisms to recover their vigor, he will then obtain colonies of the parasite.

Two questions arise: (1) Why does an organism which produces such striking results occur in the tissue in such small numbers? (2) What paralyzes it so that when agar plates are made from the tissues the colonies do not appear until the fourth, fifth, sixth, eighth or tenth day, and sometimes not until the twentieth day? These questions have received a good deal of thought. After a time we discovered that when the organism is grown in bouillon or other media containing sugar an acid is produced, and it then occurred to me that this acid might be the cause of the death of a large proportion of the organisms in the cells, and of the paralyzing of the remainder. Peptone water flask cultures of the organism were then grown in the presence of sugar and turned over to the chemist, who reported that the acid present was acetic acid. We found that after a time all the organisms in such cultures

were dead, and a microscopic examination showed that a large proportion of them occurred in the form of irregular club-shaped or Y-shaped bodies, *i. e.*, they had passed over into involution forms preceding their death. Subsequently we found that on adding dilute acetic acid to fresh cultures of the organism either on agar or in bouillon we could at will produce these involution forms. Ordinarily it was found on making poured plates from such cultures that all the organisms were dead, but by further experimenting we learned that if we added just the right quantity of acid, involution forms were produced and a portion of the bacteria killed, but that some remained alive and those which remained alive were paralyzed, coming up on the agar plates in the same slow manner as those from the interior of the tumors. I should have stated that although the organism comes up slowly from the crown-gall on agar-poured plates, sub-cultures from such colonies grow as readily as from any other easily cultivable organism, *B. coli*, for example, showing clearly that the initial slow growth is not a peculiarity due to differences in culture-media or inherent in the organism, but only one due to its previous environment in the plant cell.

Do the same phenomena occur in the plant cell? Recently from crown-gall of daisy grown for the purpose, the chemist has isolated for us an acid which he says is acetic acid. We have also found in the tissues numerous bacterial Y-shaped bodies, such as occur in our flasks when acetic acid is present. I think, therefore, we may assume, tentatively, at least, that an acid in small quantities is formed also in the cells of the crown-gall as a by-product of the bacterial growth, and that after a time this acid stops the growth of the multiplying bacteria within the cells ex-

actly as it does in the flask cultures, causing them to take on involution forms and killing the majority.

There is, as I conceive, a very delicate balance between the parasitic bacterium present in the plant and the activities of the plant cells. The cells of the plant are not destroyed by it, but only stimulated into rapid and repeated division. Upon its entrance into a cell, which must usually be by wounds, in our own experiments by needle-pricks, we may conceive the micro-organisms to multiply rapidly for a short time. The acid developed by this multiplication then inhibits the further growth of the bacteria, causing the appearance of Y-shaped bodies and the death of a certain proportion of the bacteria, sometimes nearly or quite all of them. The membrane of the bacterial cells which are killed is now permeable, and the bacterial endotoxines diffuse out into the cell. The nucleus of the cell now immediately divides, under the stimulus either of the acid or of the aforesaid endo-toxines, or possibly from an excess of carbon dioxide due to the bacterial growth. There can be no doubt, I think, that carbon dioxide exists in excess in these cells, because the crown-gall tissues contain an excess of chloroplasts in the absence of any other visible means of obtaining this necessary food. These chlorophyll bodies are so abundant as often to give a distinct green color to deep tissues wherein we would ordinarily expect to find but few chloroplasts.

The next difficulty is to explain why the paralyzed bacteria carried over into the daughter cells suddenly begin a new growth. This can result, I think, only from the pouring out into the cell at the time of division of a fluid which was not previously present in it, namely, the nuclear sap which must flood the cell as soon

as the nuclear membrane disappears. Whatever the explanation may be, the bacteria take on a new growth for a short time in the daughter cells with the reproduction of the already outlined phenomena. In this way occurs within a few weeks or months an enormous overgrowth of the tumor tissue with the development of strands and of secondary tumors as already described. Using rapidly growing favorable plants, it is possible by means of a few needle-pricks carrying in the parasitic organism to obtain a tumor as large as one's fist in as short a period as six weeks. Ordinarily, however, growth is slower. Dr. A. P. Matthews, to whom I am indebted for suggestions respecting the effect of the nuclear sap on animal cells, tells me he has observed in case of the entrance of sperm cells into the eggs of star fish that the sperm retained its original form until the breaking up of the nuclear wall and the diffusion of the nuclear sap into the egg cell, whereupon the sperm took on a rapid growth.

Although we are able by means of poured-plate cultures to isolate the organism in a pure state from young crown-galls and reproduce the disease at will, we can not readily demonstrate the presence of the organism in the tissues by means of the microscope. If the bacteria were as readily seen in crown-gall tissues as they are, for instance, in the tuberculosis of the olive, the cause of the disease would have been discovered long ago. The organism is not an acid-fast organism, and when it stains at all a great variety of cell inclusions also stain and some of these derived from the cell protoplasm or from special parts of the nucleus are confusing. Its staining is also complicated by the fact of its passing over so readily into involution forms which are proverbially difficult to stain. I have seen occasionally inside of

the cells of the crown-gall motile, flexuous, rod-shaped bodies which I take to be this organism, and we have occasionally stained in small numbers in the cells bodies which closely resemble rod-shaped bacteria, but ordinarily they occur in such small numbers or take stains so vaguely and imperfectly that this method of demonstration would not be convincing to an outsider. Also sometimes we find small groups of cells filled with what appear to be semi-disorganized bacteria, as if here the bacteria had gained the mastery for a short time and then degenerated. We have not in the whole eight years obtained any very satisfactory slides, although many attempts have been made, using a great variety of fixing agents and of stains. As I have stated elsewhere, if we had depended on the microscope alone we should not have been able to work out the etiology of this disease, and the plain demonstration of the parasite in the cells must await, I think, the development of some special technic of staining whereby we may be able to mordant the bacteria in such a way that they shall take one color while the contents of the host cell takes another. Even in case of the Y-shaped bodies one is seldom able to demonstrate them in the stained cells. We have obtained the best results by an indirect method, namely, by taking clean slides and burning the surface free from all possible organisms, then putting on a little distilled sterile water, and putting into this sections of young crown-galls taken from a portion of the tissue pared free from all exterior parts, allowing the contents of the cut cells to diffuse into the water for an hour, then removing the sections, drying the fluid and staining the slide. Examining such slides under the oil-immersion objective in course of a day one finds a good many such Y-shaped bodies. We have found the best method to be

the systematic search of the whole slide, passing it back and forth under the objective. Searched in this way, about one field in four yields a Y-shaped body. Bacterial rods have also been obtained from the tissues in this way.

Various researchers on cancer have mentioned finding rod-shaped and Y-shaped bodies in cancer cells. For example, Dr. Borrel, of the Pasteur Institute in Paris, and Dr. Reese, working in the cancer laboratory at Buffalo.

These plant neoplasms contain both small-celled and large-celled parenchyma and a variety of other tissues, *e. g.*, vessels and fibers. Cell division is sometimes so rapid that the cell wall can not keep pace. (Slides shown.) Frequently two and sometimes more nuclei are present in a cell. A portion at least of the cell divisions are by mitosis; but not all, it would seem. Some queer things take place in the cells. We are now studying the mechanism of cell-division in these tumors and are not ready to report.

To conclude, suppose we had in human cancer as its cause a microorganism multiplying in small numbers within the cell, having a definite action on cell nuclei, readily inhibited by its own by-products, losing virulence easily, passing quickly over into involution forms which are difficult to stain, and which are so paralyzed that only a very small portion will grow at all, except from the very youngest cells, and these only after a considerable period of time has elapsed, and further suppose that for their growth some very special technic of isolation, or some peculiar kind of culture media were necessary, then we should have precisely the same difficult conditions of isolation and determination as have confronted us in case of this similar overgrowth of plants, and ample explanation of why expert animal pathologists have been unable to see the parasite

in their sections, and unable to cultivate it on their culture media, and consequently, have very generally reached the conclusion that it does not exist. Granted the existence of such an organism, and we have a ready explanation for the growth of the cancer cell in defiance of the physiological needs of the organism. The hitherto inexplicable occasional change in the nature of the cell-growth of tumors, *e. g.*, from epithelial to carcinomatous and from carcinomatous to sarcomatous also finds its explanation in the presence of a sensitive microorganism growing usually in the kind of cell originally infected but capable under certain circumstances of invading other types of cells.

ERWIN F. SMITH

U. S. DEPARTMENT OF AGRICULTURE

[The illustrations accompanying this address will be reproduced at an early date in a bulletin to be published by the U. S. Department of Agriculture.]

THE ROYAL ENGINEERING COLLEGE AT CHARLOTTENBURG-BERLIN

DIE Königliche technische Hochschule zu Berlin¹ is the leading school for higher learning in technical subjects in the German Empire. It is not an imperial institution; but was founded and is supported by the state of Prussia. It is under the immediate control of the Prussian University of Public Instruction.

This school covers, in general, the same ground as the Massachusetts Institute of Technology, the Troy Polytechnic, the Stevens Institute and the schools or colleges of engineering in our own state universities, including, like that of Illinois,

¹ This term has been translated into English in many different ways: the Royal Technical College; the Technical University; etc. I prefer the one I have placed at the head of this article.

for instance, a department of architecture.²

The constitutional statute as revised in 1882 declares it to be "the purpose of the Technische Hochschule to furnish a suitable higher training for technical careers in the public service of the state and the municipalities as well as for private practise in the industrial life of the nation; and further (and this is very important) to cultivate the sciences and the arts which underlie the field of technical instruction."³

The school is divided into six departments: Architecture; Civil Engineering; Mechanical and Electrical Engineering; Marine Engineering and Construction; Chemistry and Metallurgy; and General Science, including Mathematics and the Natural Sciences.

The requirements for admission have in common for all departments the certificate of graduation from a gymnasium, real-gymnasium, or higher realschule; *i. e.*, the ordinary preparatory classical or scientific college of the German empire.⁴

A year's practical work in a shop or factory is furthermore required of those who wish to take the technical degree in mechanical or electrical engineering and in a ship yard for those who wish to take marine engineering. A shorter time of practical work suffices for the candidates

² The engineering school at the University of Illinois was organized along similar lines to those of the school at Charlottenburg. Its first dean was Dr. Nathan C. Ricker, who was a student in Germany in his early years.

³ The German never loses sight of the fact that the promotion of our scientific knowledge by original investigation and research is fundamental to all successful organization of higher education.

⁴ The normal age for completing this preparatory course is 18 years. The average age, however, and the age of the majority of the graduates is nearer 19; although many finish the course at 17 and a few at 16.

in chemistry and metallurgy. This practical experience takes the place of the school shop work in our American institutions. Half of this work may be made up in vacations during the course so that the whole period of study after the preparatory school is finished is lengthened only six months by this provision.

The course of the engineering school is four years in length and leads up to a final examination, the successful completion of which entitles one to the degree of Certificated Engineer (*Diplom-Ingenieur*).

The degree of Doctor of Engineering (*Doktor-Ingenieur*) may be obtained without further attendance on systematic courses of instruction upon the presentation of a satisfactory scientific thesis "which demonstrates the capacity of the candidate for independent scientific work in the technical field," and the passing of an oral examination.

As it ordinarily requires several months' hard work to prepare such a thesis, the candidate rarely obtains his doctor's degree within a shorter time than one year after his degree of certificated engineer is obtained; though the law does not require any specified time to elapse between the taking of the two degrees.

The thesis which is required in connection with the examination for certificated engineer will not be accepted as a doctor's thesis.

With this brief statement of fact it may be interesting to compare the course and requirements of the Royal College at Charlottenburg with our own institutions.

The normal German boy should enter the gymnasium, or *realschule*, at nine years of age and complete the course by the time he is eighteen. If he then puts in a full year in a shop he will be nineteen when he enters the Engineering College with his shop work completed. By the time he has com-

pleted his four-year engineering course and obtained the degree of certificated engineer he will be twenty-three. By spending one year more he can take his doctor's degree at twenty-four.

As seen from the above account, he can shorten this time materially. First, by completing his preparatory course at 17 instead of 18, which is easy for the capable and industrious boy; second, by putting half of his practical year into the long vacations, thus saving six months; and, third, by completing his thesis for the doctor's degree in six months which is also thoroughly feasible. A student who pursues this course could obtain his doctor's degree at twenty-two instead of twenty-four.

On the other hand, the average boy takes until he is nineteen to complete his preparatory course; wastes six months, and often a year, in "enjoying his academic freedom" and takes more than the schedule time for the doctor's degree, arriving at that point in his twenty-fifth or twenty-sixth year.

Now, take the American boy who is looking forward to the doctor's degree in engineering at, say the University of Illinois. Suppose he graduates at a good Chicago high school. He will be eighteen years old if he has pursued the normal course, *i. e.*, enters the primary school at six years of age; completes the eight grades and enters the high school at fourteen, taking the regular time of four years for the full course for graduation.

He must now take four years for the ordinary course, leading to the bachelor's degree in engineering. By this time he is twenty-two. He must then take three years' graduate work for the degree of doctor in engineering, making him twenty-five years of age—*i. e.*, one year older than the German who takes the normal time.

The American boy can abridge his course one full year by completing his preparatory course at seventeen, as he can easily do if he has brains and industry. He may cut the college course by another six months if he is specially well prepared, able and industrious and may thus take his doctor's degree at twenty-three and one half.

On the other hand, the average boy slips a cog somewhere like his German brother and loses time along the way. Our statistics show that the average age of the freshman entering the University of Illinois is a little over nineteen instead of eighteen as it should be; or seventeen as it might well be; or even sixteen, as it sometimes is. Many students lose again in college and must return for a part or the whole of a fifth year before getting their first degree. Such students, however, would rarely be considered as candidates for the doctor's degree, nor would they care themselves to attempt it.

It will thus be seen that the courses in the two countries run along somewhat parallel lines so far as the formal requirements are concerned.

The German *realschule*, or gymnasium, is, on the whole, a more thorough and effective center of training than the American high school. The teachers are better educated and the discipline is more severe. The German boy *must work* or he is thrown out of the school. The American boy is permitted to dawdle along and fool away a good portion of his time without running any serious risk of dismissal or even of being required to take the year's work over again.

In the best American high schools with properly educated teachers the American boy has a *chance* of acquiring as good a training as his German brother, or would have such a chance, if the lazy idlers in his

class could be put in a division by themselves. Under the actual circumstances, he must use one year in college, and some high authorities would say two years, in order to get as far along in real mental training and effective knowledge as the German boy when he leaves the preparatory school.

The German engineering school gives little attention to the so-called general subjects in its curriculum. These are taken care of in the preparatory school. No languages or history appear, among the required or elective subjects. Certain general subjects which have a practical value for the engineer, like commercial law, patent law, finance, political economy, etc., are listed among the possible courses to be chosen, while opportunity is also offered for courses in foreign languages—French, Russian, English, etc.

To put our American engineering schools on a par with the German as educational institutions, we must first of all improve the quality of our preparatory instruction. This will be done, not by lengthening the college course, or by merely requiring a bachelor's degree for admission; but by insisting that the student who wishes to take up engineering studies should have a thorough grounding in the elements of a liberal education, including the mother tongue, foreign languages, mathematics, history and the natural sciences. This can all be acquired by the time the student is eighteen or nineteen years of age without spending three or four years in college after leaving the high school. Perhaps a good compromise might be effected for a time by requiring one or two years of general study in an arts course as a preliminary requirement for admission to the technical courses. If mathematics and physics, chemistry and drawing, were prescribed for this college

period it might fairly enough be fixed at two years. In this way, a five years' course, after leaving the high school, could be worked out leading to a technical degree, which might then in one more year lead to a doctor's degree. The present situation is one of unstable equilibrium. Our ultimate hope lies in the development of the public high school into an effective tory instruction.

It is interesting to note how many men come up at Charlottenburg for their final examinations and the diploma and for the doctor's degree during the year. The attendance of matriculated, *i. e.*, regular students at the Hochschule during the year ending June 30, 1911, was 2,060 (average for the two semesters). Of these, 336 passed successfully the examinations for the degree of Certificated Engineer—roughly one in six of the total number. Forty-two took the doctor's degree in engineering, *i. e.*, one in fifty.

During the week I spent in a careful study of the Hochschule and its workings I was greatly impressed by the emphasis laid on training the men to independent methods of work, and by the manifest desire to turn out, not highly trained artisans or mechanics, but independent thinkers within the field of technical pursuits—men who because of their mental development will be able to lead in whatever field they may enter. EDMUND J. JAMES

CHARLOTTENBURG-BERLIN, GERMANY,
January 1, 1912

WILLIAM EMERSON DAMON

THE death of William Emerson Damon on December 1, in Windsor, Vermont, at the age of seventy-three, recalls to his friends memories of his early days, when his enthusiastic devotion to natural history studies in general, and more especially to ichthyology and pisciculture, caused him to become the leading spirit in the establishment of New

York's first aquarium. This first venture was a department of Barnum's old Ann Street museum. It was due to Mr. Damon's persuasion that the irrepressible showman was induced to undertake this enterprise; however, unexpected difficulties were encountered in securing specimens from the South Atlantic, but few of the fish being alive when they reached New York. Finally a special craft was chartered and placed under Mr. Damon's immediate control.

This was in 1863, during our Civil War, and some very interesting details regarding this expedition have been furnished by Professor Albert S. Bickmore. Barnum, who had just acquired the "Aquarial Gardens" in Boston, wrote to Professor Agassiz, of Harvard, that if the latter had an assistant whom he would like to send along to collect specimens for the Museum of Comparative Zoology in Cambridge, all facilities would be accorded to him. This offer was accepted by Agassiz, who selected Professor Bickmore as his representative. The little fishing-smack chartered for the trip was given the high-sounding name *Pacific*. Its equipment, however, was of the simplest, not even a chronometer being on board, so that when, after coasting along until Cape Hatteras was reached, the course was laid due east, and the ship passed out of sight of land, there was no means of determining its exact position. Fortunately, half-way toward Bermuda, an East-Indiaman was met, and the adventurous seamen were able to learn their precise latitude and longitude.

On the arrival of the little craft in Bermuda, Professor Bickmore writes:

As we came near Port Hamilton, the principal harbor, a number of native boats put off to board us, for what purpose we were at a loss to imagine, until one more skilfully managed than the others came alongside, and its black crew offered to aid us as agents. "What for?" we asked; to which came the rejoinder: "Why, when we saw how you could sail in a strong breeze, we felt sure you were a 'blockade-runner' loaded with tobacco."

When the entirely peaceful intentions of the newcomers were made plain, the authorities facilitated their operations and some 600

fine specimens were secured, and safely brought to New York. The beautiful Bermuda Islands were then but little known to New-Yorkers and the enthusiastic account of their charms given by both Mr. Damon and Professor Bickmore undoubtedly helped much to make that region popular with New-Yorkers and Bostonians.

To this first aquarium venture succeeded another, which was housed for some years in a building on the site now occupied by the Herald Square Theatre. A most appropriate banquet celebrated the opening of this aquarium, the menu of fifty-three courses consisting exclusively of fish. With this foundation Mr. Damon was largely interested and when, finally, the present well-equipped aquarium in Battery Park was established his advice and council were eagerly sought and he was given a deciding voice in the choice of the director.

There can be no doubt that if Mr. Damon could have found an opening enabling him to devote all his time and energies to natural history he would have earned a world-wide reputation in this field, but a leading jewelry house would have lacked his valuable services as part owner and credit-man, services extending for forty years. Nevertheless, his interest in these studies was always great and he found time to make many contributions to the progress of this branch of science. His book entitled "Ocean Wonders" records a number of very interesting experiences gained during his early researches. During his business career he was exceedingly fond of making pedestrian excursions in the environs of New York City, and thus acquired an exceptionally thorough knowledge of the formation of the land in this territory.

His lively interest in scientific pursuits and the recognition accorded him in the scientific world is shown by his membership in the New York Microscopical Society, the Royal Microscopical Society of London, the New York Mycological Club, the Scientific Alliance of New York, the New York Naturalists' Club and the New York Zoological Society. He

was also a member of the New England Society. He is survived by a widow.

GEORGE F. KUNZ

MEMORIAL TO MRS. ELLEN H. RICHARDS

THE third annual meeting and luncheon of the Home Economics Association of Greater New York, held on Saturday at the National Arts Club in that city, took the form of a memorial to Mrs. Ellen H. Richards, late of the Massachusetts Institute of Technology and president of the Lake Placid Conference of Home Economics and the American Home Economics Association. The literary program at the luncheon was in charge of Professor Helen Kinne, of the School of Household Arts, Teachers College, the president of the New York association. At the last annual meeting Mrs. Richards was present as the guest of honor and gave an address on the "Conservation of Human Resources." Miss Kinne in introducing one of the speakers, said that probably there was no member of the club whose life had not been touched and quickened by Mrs. Richards. For herself, she said, she had two mental pictures of Mrs. Richards, one in her laboratory at the Institute of Technology, and the other in her home with the flowers.

The first speaker was Miss Margaret Maltby, professor of physics in Barnard College. She told of her first contact with Mrs. Richards while she studied at the Institute in 1887 and of the constant thoughtfulness of the only woman teacher there for the girl students. She said:

Mrs. Richards in an unusual degree combined the qualities of the prophet, the scientist and the practical optimist. She was constantly anticipating lines along which advance would be made. Her imagination was based on a solid foundation of scientific fact and her prognostications were seldom wrong. Her interests were broad and were not confined to any one science. This was shown by her study of medical books, by her use of the weather charts which came daily to her home, and by her activities in many scientific societies. With all this there was a sense of proportion, an instinct for what was feasible, a practical method of attack, a wonderful power of analysis, which was

often astonishing. She was a pioneer in scientific management in the case of the individual as well as of the institution and aimed for the maximum of efficiency for the individual and the race. Environment as expressed in food, shelter and clothing was but the means to an end, the betterment of the race.

Mrs. Mary J. Lincoln, first principal of the Boston Cooking School, told of Mrs. Richards's help in the early days of that institution (now merged with Simmons College), how she sometimes lectured at the school and more often the pupils went to her. At a later period when Mrs. Lincoln was preparing a text-book for public schools, Mrs. Richards gave advice and read proof. "Be careful, that may not be so in ten years," "Better say, 'so far as we know now,'" were some of her comments which prove how her own words were to be trusted.

Of particular interest was the announcement made by Mrs. Caroline Weeks Barrett, chairman of the Ellen H. Richards Home Economics Fund committee. This committee is soon to make definite announcement regarding the memorial to Mrs. Richards which will take the form of a fund to be administered for research and publication for advancing the interests of the home.

We could not think of putting up a dead thing as a memorial to Mrs. Richards, a bronze tablet or even a building. She was a living argument for home economics. How shall we keep her alive? We must give her earthly immortality through a living memorial, something which shall continue to do Mrs. Richards's work with Mrs. Richards's spirit. For this woman who believed in the impossible and helped it to come to pass it is not impossible for us to raise a hundred thousand dollars in dollar subscriptions from those who have felt her influence, to be invested by a board of trustees and used under their direction to establish the *Journal of Home Economics* and later for lectureships, research and publication according to the needs of the time. The collection of funds by personal canvass is soon to be initiated in a country-wide campaign which will enlist committees numbering over a thousand persons who will seek this uniform democratic contribution from men and women interested in advancing the welfare of the home through a memorial to this

woman who as scientist and social engineer did so much for the home.

SCIENTIFIC NOTES AND NEWS

AMONG the British New Year's honors are knighthoods conferred on Professor W. F. Barrett, F.R.S., formerly professor of physics in the Royal College of Science, Dublin, and Professor E. B. Tylor, F.R.S., emeritus professor of anthropology in the University of Oxford.

M. LIPPMAN has been elected president, and Professor Guyon vice-president, of the Paris Academy of Sciences.

THE Academy of Sciences at Bologna has awarded the Élie de Cyon prize of 3,000 lire to Professor E. A. Schäfer, of Edinburgh.

THE senate of St. Andrews University has resolved to confer honorary degrees *in absentia* upon gentlemen chosen for the degrees on the occasion of the celebration of the five hundredth anniversary of the foundation of the university in September last, but who were unable to be present. Among them is Dr. Charles D. Walcott, geologist, and secretary of the Smithsonian Institution.

COLUMBIA UNIVERSITY has designated as Jesup lecturer for 1912-13 Professor H. T. Morgan, of the department of zoology. His lectures will be delivered at the American Museum of Natural History. Professor W. P. Montague, of the department of philosophy, has been appointed to deliver the Hewitt lectures at Cooper Union in the spring of 1913.

MR. RAYMOND A. PEARSON has resigned the office of commissioner of agriculture of the state of New York.

PROFESSOR JOHN B. WATSON, of the Johns Hopkins University, has recently been granted a three years' appointment as a research associate of the Carnegie Institution of Washington, in order that he may study the migratory and other instincts of the sea-gulls of the Tortugas, Florida.

AN expedition to Montego Bay, Jamaica, is about to be undertaken by the department of marine biology of the Carnegie Institution of Washington. In addition to the director, the

investigators will consist of Professors David H. Tennent, Gilman A. Drew, Robert Tracy Jackson, H. L. Clark, H. E. Jordan, R. L. Cary and E. E. Reinke. Mr. George Gray, of Woods Hole, will accompany the expedition as collector.

PROFESSOR M. M. METCALF, head of the department of zoology of Oberlin College, has been granted leave of absence for the second semester to carry on research work in the Marine Laboratory of the University of California.

FREDERICK STARR, associate professor of anthropology at the University of Chicago, returned on January 1 from a four months' journey through Korea. Professor Starr has been made a Commander of the Order of Leopold II., by King Albert, of Belgium.

MR. WILFRED H. OSGOOD, of the Field Museum of Natural History, accompanied by Mr. Malcolm P. Anderson, sailed on January 27 from New Orleans to Colon, *en route* to the west coast of South America and the Peruvian Andes. They will spend six to nine months collecting mammals and birds and studying the general faunal conditions in that region.

PROFESSOR C. V. PIPER, of the United States Department of Agriculture, has returned to Washington after a year's absence in the orient. Six months of this time were spent in the Philippine Islands investigating the possibilities of producing hay in the Philippines for the use of army horses. The remaining time was devoted mainly to a study of the agricultural conditions in India. Professor Piper brought back with him a large lot of seeds, principally grasses and legumes, which promise to be of value in the southern states and West Indies.

THE eighth lecture of the Harvey Society series will be delivered by Professor T. W. Richards, of Harvard University, on Saturday, February 3, 1912, at 8.30 P.M., at the New York Academy of Medicine, 17 West 43d Street. The subject is: "The Relations of Modern Chemistry to Medicine."

PROFESSOR W. L. TOWER, of the University of Chicago, delivered a lecture on December

20 to the members of the Science Club of the Kansas State Agricultural College at Manhattan on "The Modification of the Germ Plasm and Inheritance."

PROFESSOR D. H. TENNENT, of Bryn Mawr College, gave an afternoon and an evening lecture at Oberlin, on January 17, upon "Variation and Heredity in Echinoderms," basing his discussion on his hybridization experiments and the cytological analysis of their results.

DR. BARTON WARREN EVERMANN, chief of the Alaska Fisheries Service, U. S. Bureau of Fisheries, lectured before the Buffalo Society of Natural Sciences on Friday evening, January 19, on "The Alaska Fur-seal and the Fur-seal Question." He strongly approved the government policy of killing the surplus 3-year-old males, after making ample reservations for breeding purposes.

PROFESSOR LAFAYETTE B. MENDEL, of Yale University, gave an illustrated lecture before the Columbia University Chapter of the Sigma Xi Society on January 18, on "Nutrition and Growth."

PROFESSOR J. McKEEN CATTELL, of Columbia University, gave the foundation address at Indiana University on the morning of January 19. In the afternoon he spoke before the faculties on "Grades and Credits," and in the evening addressed the Society of Sigma Xi. On January 22, he gave an address before the faculties of the University of Illinois on "The Administration of a University," and in the evening discussed the question with the committee charged with framing a constitution for the university. On January 5, Professor Cattell gave an address at Lehigh University and in the evening addressed the faculties of Lehigh University and Lafayette College.

THE department of Natural History of the College of the City of New York announces the following public lectures, which will be given on Thursday afternoons at 4 o'clock:

February 8—Professor N. L. Britton, director of the New York Botanical Gardens: "Scenic and Floral Features of Cuba."

February 29—Dr. C. H. Townsend, director of

the New York Aquarium: "The Voyage of the *Albatross* to the Gulf of California."

March 7—Dr. C. William Beebe, curator of birds, New York Zoological Park: "Adventures of an Ornithologist in the Far East."

March 21—Dr. R. H. Lowie, assistant curator of anthropology, American Museum of Natural History: "An Ethnologist in the Field."

THE Naples Table Association for promoting Laboratory Research by Women calls attention to the opportunities for research in zoology, botany and physiology provided by the foundation of this table. The year of the association begins in April and all applications for the year 1912-13 should be sent to the secretary on or before March 1, 1912. A prize of \$1,000 has been offered periodically by the association for the best thesis written by a woman on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological (including psychological), chemical or physical science. In April, 1911, the prize was named the Ellen Richards Research Prize. The sixth prize will be awarded in April, 1913. Application blanks, information in regard to the advantages at Naples for research and collection of material, and circulars giving the conditions of the award of the prize will be furnished by the secretary, Mrs. A. D. Mead, 283 Wayland Ave., Providence, R. I.

THE chairman of the finance committee of the New York Academy of Medicine, in sending out to members the treasurer's report, states that \$110,000 has been raised by subscription from about one fourth of the members, and that it is expected to collect about double that sum within the academy in order to pay for the real estate purchased as a site for the proposed enlarged building, before appealing to the general public for funds.

THE extension of the Horniman Museum, Forest Hill, consisting of a lecture hall and a new library, the gift of Mr. E. J. Horniman, son of the donor of the museum, was opened on January 27, by Sir Archibald Geikie, K.C.B., president of the Royal Society.

MR. ROBERT WILCOX SAYLES, in charge of the geological section of the Harvard University

Museum, has given the sum of \$5,000 to the Seismological Society of America, to aid in the publication of the Society's *Bulletin*.

THE Field Museum of Natural History, Chicago, has acquired recently, through purchase, the herbarium and botanical library of the late J. H. Schuette, of Green Bay, Wisconsin. The collection comprises 15,000 to 20,000 carefully prepared and fully labelled herbarium specimens, principally from Wisconsin, well representing the flora of the state. In addition to the general collection there is a valuable series of native American roses, the particular group of plants in which Mr. Schuette was for many years deeply interested and to which he gave critical study.

AMONG the dispositions of the will of Dr. O. M. Lannelongue, professor of surgery at the University of Paris, are the following: An annual sum of \$100 is left to the University of Paris, the same sum to the Faculty of Medicine for assisting necessitous students, and a sum of \$35,000 for the establishment of a museum, for which material had already been collected, in his native town, Castéra-Verduzan. Various other benefactions are conferred upon the town of Castéra-Verduzan. The residue of the property is to go towards the creation of some national or international work of a social or scientific order.

MR. CHARLES G. ABBOT, director of the Smithsonian Astrophysical Observatory, has returned to Washington from Bassour, Algeria, where he has been making astrophysical observations, in regard to the solar constant of radiation. The observing station in Bassour was established in July, 1911, when Mr. Abbot and his field assistant, Professor Frank P. Brackett, of Pomona College, arrived in Algeria, and observations were continued until the end of November. From previous work at Washington, Mount Wilson and Mount Whitney, it had been determined that the sun was probably a variable star, and that apparently its radiations frequently fluctuated from 2 to 5 per cent., during irregular periods of from five to ten days duration. Although strongly indicated by the work on Mount Wil-

son, the result was so important that it seemed necessary to test it further, by means of simultaneous independent observations held at Mount Wilson and some other high altitude station remote from there, where an equally cloudless atmosphere existed. These duplicate observations would eliminate all errors due to local atmospheric conditions. Mr. Abbot made complete determinations of the solar constant of radiation for forty-four days, in Bassour, while his assistant, Mr. L. B. Aldrich, made similar measurements at Mount Wilson, Cal. The two observing stations were separated by a distance nearly equal to that of one third the circumference of the earth. Unfortunately some cloudy weather was encountered at each of the stations, but the records of about thirty days will be available for comparison. If it seems necessary to make additional measurements it will be possible to continue the work this year, during June, July and August.

MORE than 200,000,000 barrels of oil, with a value of nearly \$128,000,000, were produced in the United States last year, according to David T. Day, of the United States Geological Survey, in an advance chapter on petroleum from "Mineral Resources of the United States" for 1910. The petroleum industry in the United States, says Dr. Day, has been characterized by a phenomenal increase each year for the last four years. Each year's gain over that of the year before has been so remarkable as to lead to the belief that the limit of production had been reached, but the increase has continued rapidly. After varying between 50,000,000 and 60,000,000 barrels annually in the decade between 1890 and 1900, the oil output was over 63,000,000 barrels in 1900 and increased to 88,000,000 barrels in 1902. In 1903 it passed the 100,000,000-barrel mark, in 1904 it was over 170,000,000 barrels, and in 1905 nearly 135,000,000 barrels. After a slight decline in 1906 the output rose again, in 1907 reaching 166,000,000 barrels. It was 178,000,000 barrels in 1908, 183,000,000 barrels in 1909, and 209,556,048 barrels in 1910, a gain of 14 per cent. over the record output of 1909. This brought

the total output since the beginning of the petroleum industry to more than two billion barrels. The United States is now by far the greatest oil-producing country; in fact, it produces more than all the rest of the world together. In 1910 the wells of this country yielded nearly 64 per cent. of the total production, Russia scoring a very poor second with about 70,000,000 barrels, or 21 per cent. The production of other countries is comparatively negligible, the third on the list, Galicia, contributing only 3.87 per cent. of the total. The excess of the petroleum production of the United States over the normal demand is shown by the fact that the 209,556,048 barrels produced in 1910 brought a smaller return—\$127,896,328—than the 183,170,874 barrels in 1909, which was valued at \$128,328,427. The even smaller output in 1908, 178,000,000 barrels, was valued at still more—\$129,079,184. As the production has increased the average price has gone down from more than \$1 a barrel in 1900 to 61 cents in 1910. These repeated great increases in oil production have been due to the successive development of four great petroleum fields farther west than the old productive centers. By 1900 the country had adapted itself to the influx of oil from western Ohio and Indiana; then came in rapid succession the development of the Gulf field in Texas and Louisiana, the Mid-Continent field in Oklahoma and Kansas, and the Illinois field. In the meantime California's production had been increasing so rapidly that it became the dominant feature of 1909 and 1910, outstripping the production of any other state and promising to retain this supremacy in the future. The trade effect of these developments was largely discounted by the small proportion of gasoline and kerosene yielded by the Gulf and California oils and it was only when the superior character of the Mid-Continent oil was recognized that the middle western contributions began to be taken seriously in the general trade. Geographic and technical factors put California petroleum at a disadvantage compared with the eastern supply,

but the great production has compelled such advances in refining methods as to make it reasonably certain that California will in the future yield good refined products, including lubricating and illuminating oils.

THE results of the latest tests on reinforced concrete, conducted in the College of Engineering of the University of Wisconsin, have just been published by the university. In this bulletin suggestions are made as to the most economical mixture of cement, sand and gravel in making the concrete. It also contains data concerning the strength of different forms of reinforced columns. The loads that may be safely used in designing reinforced concrete columns and the strength of columns resting upon small footings are also dealt with, and conclusions given as to the behavior of the latter. The work in this field has been in progress for about ten years at the University of Wisconsin and the bulletin just published supplements one published about three years ago.

UNIVERSITY AND EDUCATIONAL NEWS

THE directors of Bryn Mawr College have formally accepted the bequest of \$750,000, made by the will of Emma Carola Woerishoffer, of New York, who was killed in an automobile accident last summer. The whole sum has been constituted as a permanent endowment fund, to be named the Emma Carola Woerishoffer Endowment Fund. A scholarship has been founded at the college in memory of Miss Anna Hallowell, of Philadelphia, by her family. The interest of the \$2,500 which is given will be used as a scholarship for an undergraduate student each year.

THE sum of \$50,000 has been given to Beloit College by Mrs. Rufus H. Sage, of Chicago, and will be applied to the endowment of the chair of English literature. The total endowment of the college—in active, interest-bearing securities—is now increased to \$1,251,000, aside from the value of the buildings.

THE University of California announces the establishment by Mr. F. M. Smith, of Oakland, California, of a research fellowship for

investigation of certain problems incident to the growth of cities in the San Francisco Bay region. Attention is to be directed especially to questions relating to the development of parks, playgrounds and other community interests demanding particular consideration of space available for growth. The stipend of the fellowship is \$1,000 per annum, and an additional sum of \$500 annually is provided for expenses of the investigation.

BUILDING operations on the new auditorium of the University of Michigan, made possible by Regent Hill's bequest of \$200,000, will soon be under way. The site has been chosen with a view to commanding a convenient approach when the campus extension plans shall have been carried out. The auditorium, with its two galleries, will have a seating capacity of 5,500.

M. GEORGES LEYGUES has given 25,000 francs to the University of Paris for the new Institute of Chemistry.

THE faculty of the College of Arts and Sciences of the University of Maine has made a change in the requirements for the B.A. degree, abolishing the requirement of ten hours in the classical department. Hereafter, neither Latin nor Greek will be required for admission to the college, nor for the B.A. degree. A broad group system has been adopted within which a student, under the advice of his major instructor and with certain restrictions, may elect his own course.

THE board of trustees of the College of the City of New York has authorized the opening of the college courses to mature and properly qualified applicants who do not wish to pursue the full curriculum leading to a degree. In the department of chemistry special courses are offered in analytical, industrial, organic, physical and electrochemistry with opportunities for investigation. Full particulars may be had by addressing Professor Charles Baskerville, College of the City of New York.

ANNOUNCEMENT is made that the formal inauguration of Dr. John Grier Hibben as president of Princeton University will take place early in May. Dr. Hibben will continue to

give his course of lectures on philosophy under the auspices of the Graduate School, and it is expected that he will continue to give at least one course to the undergraduates.

DR. HENRY LOUIS SMITH, president of Davidson College, has been elected president of Washington and Lee University.

MR. H. R. FULTON, associate professor of botany in the Pennsylvania State College, has been elected to the professorship of botany and vegetable pathology in North Carolina College of Agriculture and Mechanical Arts.

BEVERLY W. KUNKLE, now instructor in the Yale Sheffield Scientific School, has been appointed to the chair of zoology at Beloit College to assume his duties in September.

IN Macdonald College, Ste. Anne de Bellevue, Quebec, the following have been appointed to fill the positions named: *Lecturer in Biology*: W. P. Fraser, M.A., Pictou, N. S. *Lecturer in Poultry and Poultry Management*: M. A. Jull, B.S.A., at present Live Stock Commissioner of the Province of British Columbia. *Assistant in Animal Husbandry*: W. J. Reid, B.S.A. *Assistant in Biology*: Peter I. Bryce.

DISCUSSION AND CORRESPONDENCE

"PHENOTYPE" AND "CLONE"

IN calling attention to the frequent misuse of the words "genotype" and "pure line," Jennings says¹ that the word "phenotype" "designates a group of organisms which in outward appearance seem to belong to one type, although in hereditary constitution they may actually differ greatly. *Genotype*, in Johannsen's usage, is not directly contrasted with phenotype," etc.

As I have also used "phenotype" with the meaning indicated by Jennings, I did not recognize the fundamental misconception involved in the quotation given above, when I wrote my note² in response to the article from which this quotation is taken. My attention has been called to this point by Dr. Johannsen, and it seems best to set the matter straight at once, in connection with the at-

¹ SCIENCE, December 15, 1911.

² SCIENCE, January 5, 1912.

tempt made by Jennings and seconded by myself, to restrict to their original meanings, the other terms introduced by Johannsen. "Phenotype" and "genotype," when both are rightly used, are *contrasted terms*, both being *abstractions* referring to the *type* to which an individual or group of individuals belongs, and *not to the group of individuals* belonging to that type. To illustrate the use of "phenotype" in its correct sense, reference may be made to the F_2 of a Mendelian hybrid. When an F_1 hybrid whose genotypic constitution may be represented by the formula, $XXAaBb$, is self-fertilized or crossed with another individual having the same formula, there will be possessed by different individuals among the offspring nine different genotypes, but only four different phenotypes. The nine genotypes may be represented by the formulæ: $XXAABB$, $XXAABb$, $XXAaBB$, $XXAabb$, $XXaaBB$, $XXAaBb$, $XXAabb$, $XXaaBb$ and $XXaabb$. The four phenotypes may in similar manner be indicated by the formulæ: XAB , XAb , XaB and Xab . As the "phenotype" is the "type of the phenomenon"—the type of that which actually appears—there must always be as many distinguishable groups of individuals as there are phenotypes; hence, the readiness with which the word "phenotype" has been misinterpreted and applied to the group of apparently equal individuals instead of the constitution or assemblage of characteristics with respect to which such a group of individuals is apparently homogeneous.

There is at present no satisfactory word universally applicable to all groups of individuals possessing the same phenotype—the concept for which the word "phenotype" itself has been misused. The words "species" and "sub-species" used by taxonomists are applicable, at least in some cases, to groups of such phenotypically equal individuals, but no one would think at present of applying either of these words to all the numerous slightly differentiated groups which the geneticist is now able to distinguish and with which he is obliged to work. A short and appropriate word for all such groups of individuals,

of whatever degree of differentiation, is greatly needed.

In my discussion of "clone" as a suitable name for any group of plants or animals which has been formed from a single original individual by purely vegetative methods of reproduction, I suggested the restriction of the term to groups of genotypically identical individuals. Further consideration convinces me that this restriction is highly undesirable because it is impracticable. It would be quite impossible to know for a certainty that two twigs used as cuttings or cions from the same tree had the same genotypic constitution, and consequently there could be no security in the assumption that they were members of the same clone, if the definition given in my previous note should be maintained. I wish, therefore, to offer an amendment to that definition by striking out such restriction. The definition may then read: "Clone, a group of individuals traceable through asexual reproductions (including parthenogenesis when unaccompanied by genotypic segregation) to a single ancestral zygote, or else perpetually asexual." This definition puts the word "clone" on exactly the same footing as the expression "pure line," making it a purely genealogical term and involving no implication whatever as to the genotypic equality of the individuals included in the single clone.

GEO. H. SHULL

THE PRIBILOF FUR SEAL HERD

TO THE EDITOR OF SCIENCE: In SCIENCE of October 27, 1911, page 568, there appears an article entitled, "The Pribilof Fur Seal Herd, and the Prospects for its Increase," signed by C. H. Townsend, member of the Advisory Board of the Fur Seal Service.

Dr. Townsend in his article handles rather severely certain persons "whose opinions upon the subject are of little value." I cheerfully admit that I am one of the persons referred to, and I shall be equally frank to say that I am sorry Dr. Townsend feels the way he does, for at the bottom we both desire the same thing, namely, the rehabilitation and preservation of the fur seal herd.

A scientist who desires his opinions upon any subject to be of value must, above all, be accurate as to his facts. In his article Dr. Townsend tells us that "The hook-worm is one of the contributing causes to heavy annual losses among the young seals born on sandy areas."

In view of this statement, I would like to call Dr. Townsend's attention to the report of Walter I. Lembkey, agent in charge of the Alaskan Seal Fisheries, dated December 14, 1906 (page 274), printed as Appendix A to Hearings on House Resolutions No. 73:

Inquiries have been made recently of the Department concerning the present effect of *Uncinaria* on the seal pups, and it has been strongly intimated by certain persons that thousands of pups die annually from the ravages of this parasite, of which no report is made in the agent's report. The fact is that *Uncinaria* has not now, nor has had for several years past, any known existence on the islands. This statement is justified by actual and careful examinations during the last three years.

Also to the report of Harold Heath's "Special Investigation of the Alaska Fur Seal Rookeries, 1910" (same publication as cited above, page 1223):

In earlier times the ravages of the parasitic worm *Uncinaria* were especially noticeable on the Tolstoi sand flat and portions of Zapadni; but in recent years, due to shrinkage of the herd, these areas have been abandoned. Very few cases were noted by Dr. Chichester in 1909, and not one was detected this year. The dead pups dissected were seemingly in a perfectly normal condition, their emaciated appearance and empty alimentary canal indicating death from starvation.

On the question of the closed season Dr. Townsend is especially severe. He tells us that a cessation of slaughtering seals would be "positively dangerous," because of the rapid increase in fighting males. I once made the suggestion to him, favorably received at the time, that as the old bulls haul out on the breeding grounds some ten days in advance of the females, it would be rather a simple matter for the agent in charge and his Indians, armed with a few modern rifles, to dispose of these dangerous surplus bulls. But a far

better answer is found in the fact that years before the club and the gun were used upon the seals the herds thrived and increased, and the more powerful bulls fought their way into the breeding grounds and did their part in creating a strong and virile race that was numbered by millions instead of the few thousands that are left to-day.

The tide of life on the fur islands has reached its lowest ebb. Dr. Townsend himself says that "the stock of females has reached the lowest limit in the history of the Islands." The objectionable persons, of whom I am one, have based their beliefs and opinions not on the conflicting reports of scientists, but on the broad principle that when any species of wild life has become so depleted as to be in danger of extinction, the best remedy is to let it absolutely alone. In this connection I wish to quote President David Starr Jordan, of Stanford University, and also a member of the Advisory Board of the Fur Seal Service:

With men, as with animals, "Like the seed is the harvest." In every vicissitude of race of men or of breed of animals, it is always those who are left who determine what the future shall be.

All progress in whatever direction is conditioned on selective breeding. There is no permanent advance not dependent on advance in the type of parenthood. There is no decline except that arising from breeding from the second-best instead of the best.

The survival of the fittest in the struggle for existence is the primal moving cause of race progress and of race changes. In the red stress of human history, this natural process of selection is sometimes reversed. A reversal of selection is the beginning of degradation. It is degradation itself.

Natural conditions should be the rule, and all killing of selected males for commercial purposes should absolutely cease until the tide of increase in the fur seal herd has once more set toward the flood.

MARSHALL McLEAN,

Member of the Camp Fire Club's Committee on Game Protective Legislation

NEW YORK,

January 2, 1912

QUOTATIONS

THE PRESIDENCY OF THE UNIVERSITY OF MONTANA

For the first time the state board of education permits me, although solely through newspaper reports, to have a statement of considerations which influenced its members in voting "not to renew Dr. Duniway's contract at the close of the year, September 1, 1912."

To the extent that official propriety permits me, and without entering into controversies with my superior officers, I feel obliged to call attention to certain features of this report.

The basis for the action of the state board is said to be primarily a report of the university committee, following an investigation of university affairs made in Missoula on October 22 and 23. It should be borne in mind that this so-called investigation was made without notice to the president of the university, and at a time when he was out of the state. The summing of members of the faculty, of alumni and of students, was prearranged by the chairman of the committee. Under the circumstances there was no opportunity, and there seems to have been no expectation to extend the scope of the inquiry to make it fairly representative of the prevailing opinions and the essential facts which ought to have been considered. Any fair-minded person is entitled to draw his own conclusions concerning such a situation.

It will conduce to clearness if the report of the committee, as published, is briefly considered, point by point. Its essence is found in these statements: First: "We find there is a spirit of unrest and dissatisfaction existing between the student body and the president"; second, "There is dissatisfaction between the alumni and the president"; third, "A lack of cooperation and coordination existing between the president and a large portion of his faculty"; fourth, "We find that the president is exceedingly unpopular among the high school students of the state." A fifth point is added, said to be derived from the general discussion, "That President Duniway does not visit classrooms to ascertain at first-hand the

value of the services of any professor." Perhaps a sixth point should be enumerated to the effect that these other points "seriously retard the growth of the institution and impair the usefulness thereof."

With respect to the allegation that there is a spirit of unrest and dissatisfaction existing between the student body and the president it would be interesting to know just how many and just what students were examined upon this point. As far as such information has come to the president by indirection and rumor, it would appear that a considerable proportion of such students were those who have personal reasons for "dissatisfaction." In the course of administering a clean athletic policy and reasonable standards of scholarship, together with correct principles of conduct, the president has found it necessary to deal more or less sternly with some, at least, whose opinions seem to have impressed the committee. The process that was used to obtain student sentiment is noteworthy, chiefly because of the absence of students whose chief concern is scholarly work or scholarly distinction. To the members of the faculty it has appeared somewhat remarkable that the management of general student affairs in the university has been accompanied with so little friction and with so much genuine good will.

With regard to the second point on the alleged dissatisfaction between the alumni and the president, it is noteworthy that the "request of certain of the alumni" which is said to have produced this investigation was signed by two members of the class of 1911, the other three being undergraduates. One of these graduates had been severely disciplined for various delinquencies, both under the preceding and present administrations. How many alumni, apart from these two, testified is quite unknown to the president. A few persons seemed to be considered "the alumni." It should be added that some of the alumni, like some of the students, have been "dissatisfied" with the president's enforcement of athletic eligibility rules and his neces-

sarily vigorous efforts to prevent professionals from getting places on football teams. A very few also have been displeased because the president declined to perpetuate a so-called honor society, oathbound and secret in character, composed of three members of the faculty and a handful of third and fourth year men. Such an organization was not a healthy influence with regard either to the general student body or to the faculty, whatever may have been its ideals and hopes in its earlier history. A very few also, when they heard of discipline being applied to members of their fraternity chapters, were more or less critical. Certainly a judicious inquiry would consider questions of the animus and credibility of witnesses. Finally, it should be remarked that there has been no expression by "the alumni" of dissatisfaction with the president. On the contrary, many of them have been exceedingly helpful and most cordial in advancing the plans of the president.

With regard to the third point on lack of cooperation between the president and "a large portion of his faculty," it is difficult to see any real justification for such a statement. In an authorized interview published in the *Missoula Sentinel* on October 25 the chairman of the committee is quoted as saying that he "desires to correct the statement published by the *Sentinel* yesterday that any of the faculty had been disloyal to Dr. Duniway." The members of the faculty who were summoned before the university committee voluntarily and individually told the president that they had not been dissatisfied with the administration and that they had so testified to the committee. It would seem that the committee has construed a reasonable amount of candid difference of opinion such as right-minded members of any faculty are sure to feel into "lack of cooperation and coordination." If such a supposition does not fully explain this point is it not reasonable to think that what psychologists call "reaction to external stimuli" might have been produced in a few cases where members of the board let it be known that they were looking for criticism?

Certainly, until October last the president had felt that his relations with the faculty were unusually satisfactory, and he has had very little reason to change his opinion since that time.

The fourth point in the committee's report alleges that the president is exceedingly unpopular among the high school students of the state. Regarding the basis of this charge and the credibility of any testimony to that effect nothing can be said, when nothing is known of the witnesses or their statements. If the truth on this matter is to be ascertained it should be elicited by inquiries from the high schools of the state. It would be most interesting to have high school teachers and their older students, and recent graduates, really express themselves on such a point as this, provided it seems important. The reasons stated by large numbers of the recent freshmen classes of the university when asked to tell why they came to the institution furnished interesting testimony in contradiction of the allegation as made.

It would take too much space to deal adequately with the criticism upon the president for not visiting classrooms. Just a few direct statements may be made. In the first place the board has known, at least since June of 1910, that the president believes any general visiting of university classes by him to be unwise. The board has also known since June of 1910 that the president admits the wisdom of visiting classrooms and laboratories in certain instances and in elementary work. Furthermore the president has visited many laboratories and classes in the university during the last year and a half. An overwhelming majority of college and university presidents do not make a practise of visiting classrooms and declare that such a practise would be unadvisable. Methods that produce good results in the public school system are not applicable to a university faculty composed of highly-trained experts.

It is then declared in general that the president and his policies "seriously retard the growth of the university and impair the usefulness thereof." In the face of the growth

of the university in the last two years, one may fairly call this an amazing statement. In December of 1909 the registration of the university for the current term was 145. In December of 1910 the number had risen to 176. In December of 1911 the number had risen to 191. Let it then be remembered that these are the figures for students of university grade, not including a preparatory department, special music students, or any short-course students—classes which swell the total attendance reported for many institutions. If the unpopularity of the president retards the growth of the university is it not interesting that the last two freshmen classes have been the largest in the history of the institution? If this unpopularity causes the university "to lose many students of the state, and is the reason for many of them going east to school when they should go to the university of their own state," is it not interesting that the same problem of migrating students exists in every western state, and that 21 students have entered the university this semester with advanced standing from other colleges or universities?

The whole tone of the university committee's report presents a curious contrast to the language of the following resolution unanimously adopted by the state board of education on June 6, 1911: "We express our commendation and approval of the highly efficient manner in which he has conducted the affairs of the state university, and express our appreciation of the executive and administrative ability shown by him since he has been president of said institution."

An understanding of the procedure of the state board at its December meeting can be reached only by remembering that the sessions of the board, with its presentation of the committee's report, its discussion of the same, and its action upon it, were held and concluded without conference with the president. The president was in Helena at the time, dealt with the university committee on various matters, attended the open sessions of the board, and informed members of the university committee that he would be in immediate

attendance in the capitol building if his presence were desired for the consideration of any matter affecting himself or the university. He was personally assured that nothing of any importance would come up. After the adjournment of the board, certain of its members told him that no action had been taken, and they made similar statements to reporters, who published their declaration in the newspapers.

All of this leads to the inquiry as to what really happened between June 6, 1911, and October last, when certain very important questions which were up for discussion and settlement during that interval must have seriously changed the relations of the president and members of the board. Since the published statement under consideration does not touch upon these subjects, considerations of official reserve preclude more than this allusion to them at this time.

If I may permit myself now to speak in the first person let me conclude by saying that no one can regret more than myself the necessity of discussing educational matters in this way. Since the board has denied to me the usual academic privilege of meeting them face to face for frank discussion and has chosen to say nothing to me except through newspaper reports I am compelled to follow their example. Only the consideration that the people of the state of Montana need to be informed for the protection of higher education, and of their state university in particular, leads me to address the same public before whom the university committee's report has been placed. I hope that the publicity given to these issues may result in nothing but good for higher education in Montana.—C. A. DUNIWAY, in *The Missoulian*.

SCIENTIFIC BOOKS

The Life of the Crustacea. By W. T. CALMAN, Sc.D. New York, The Macmillan Co. 1911. Pp. xiv + 290, with 32 plates and 85 figures in the text.

While the Crustacea have attracted many generations of able students, and while they possess a truly ponderous and rapidly growing

scientific literature, few attempts have been made at a popular exposition. All the more welcome is the work under review, in which the author, a well-known student and writer in this particular field, presents a sketch of the entire class, as a whole. His expressed purpose is to describe in particular the habits and modes of life, as well as "provide for readers unfamiliar with the technicalities of zoology an account of the more important scientific problems suggested by a study of the living animals in relation to their environment."

Excepting alone the insects, the Crustacea are perhaps the most diversified and the most interesting single class of invertebrates. In their multitudinous forms, whether in the seas, the fresh waters, or upon land, they offer a peculiarly attractive field for the study of nearly every problem raised by modern biology, including development, variation, sex, heredity, parasitism and other phases of evolution. The field is both difficult and alluring. We think that Dr. Calman has succeeded admirably in bringing together a host of significant facts bearing upon his subject, and in presenting them in a logical and interesting manner.

A chapter is devoted to the European lobster, considered as an exponent of the class, and following this are sections on Classification and Metamorphosis. Successive chapters (V.-X.) treat of Crustacea of the Seashore, the Deep Sea, Floating Crustacea of the Ocean, Crustacea of Fresh Waters, the Land, as Parasites and Messmates, all loaded with interesting facts and suggestions. A section devoted to "Crustacea in Relation to Man" is less satisfactory. The volume concludes with a review of Fossil Crustacea. The illustrations are both ample and good.

The author speaks from a wide and accurate knowledge of his subject, and such errors as we have noticed are of a minor character. In the superabundance of available materials, every student of this group is bound to find many omissions of matters more or less interesting or important. In the chapter on the lobster a number of statements need to be

revised in order to accord with our present knowledge of this form. We will note the following: The "liver" is now known to be both a digestive and absorbent organ, the finer particles of food being delivered to it directly from the pyloric end of the stomach-sac. The idea that when a "limb is cast off," the opening at the breaking plane becomes closed by a clot of blood, and that further bleeding is thus stopped, had been proved by Emmel to be an error; the stoppage is effected by definite valves, without which the animal would doubtless bleed to death.

A third species of lobster (*Homarus capensis*) is attributed to the Cape of Good Hope. We were under the impression that this shadowy species had never recovered from the aspersions cast upon it by Professor Huxley. Regarding the relation of the young crayfish to its mother (p. 77) many new facts have been brought to light by the studies of Andrews for both *Astacus* and *Cambarus*.

In discussing the phosphorescence of deep-sea crustacea (p. 126) it is noticed that many luminous forms are blind, but that in such cases luminous secretions are emitted from the skin without the aid of specially differentiated organs, the photophores, the complete meaning of which is puzzling, not to say embarrassing, as in certain prawns which illuminate their gill-chambers. We are reminded of a similar trouble regarding the ubiquitous tegumental glands, which occur among other places in the labrum, swimmerets, statocysts, the intestine and the gills. It might be interesting to inquire whether there is any relation between these organs and such parts of the skin as are responsible for the secretions referred to above. In another place it stated that while many deep-sea species are some tint of red, their eggs are blue or green. If these forms were originally emigrants from shallow water, the colors of the eggs would appear to have remained stable notwithstanding the change in the color and habits of the adult, a condition which is paralleled in certain birds like the magpie, wherein the mottled coloring of the egg is evidently older than the habit of covering the nest.

The author suggests that the exceedingly long, attenuated, and often hirsute character of the appendages of deep-sea crustacea may be an adaptation to prevent the animal from sinking in the ooze; we should rather regard such conditions as aids to the animals for feeling their way in the darkness, in other words, as means for increasing their exploratory powers, and for rendering the chemical sense and that of touch more effective.

Regarding the question of metamorphosis among crustacea of the abyss Dr. Calman remarks: "It would seem that, some way or other, the conditions were unfavorable for a free-swimming larval life; but they can not be altogether prohibitive, for many deep-sea crustacea have small eggs, and presumably a metamorphosis." There is certainly no doubt that such species with small eggs undergo a metamorphosis, but it does not follow that the young ascend a mile or more to the surface in order to accomplish it. Such young may pertain exclusively to the hypoplankton and keep near the bottom, or to the mesoplankton in strata not far above it. It would be interesting to know to what extent larvæ like those of lobsters and crabs which keep for a time at least near the surface, and belong to the epiplankton, can adapt themselves to the changes in pressure involved in falling through measured distances in the water. Experiments to settle this point could be made without great difficulty.

The author thus speaks of the various animals which form the floating population of the Sargassum: "All of them are colored olive-green, like the weed among which they live." Now the Sargassum which we have repeatedly encountered in the Gulf Stream in going to or from the West Indies was always a beautiful golden brown tint, flecked with white, the light spots being due to bryozoa which commonly encrust the floats of this plant. Moreover, the entire population—fish (*Pterophryne*), shrimp and a nudibranch mollusk—wore the same colors, and usually in the same simple pattern, brown with obliterative white spots.

To conclude, in the chapter on the Relation of the Crustacea to Man we miss any adequate account of the valuable lobster fisheries of the old and new worlds, or of the laborious experiments which have been made to rear the young of this much-prized crustacean, and which in America have finally led to success.

FRANCIS H. HERRICK

WESTERN RESERVE UNIVERSITY

Qualitative Chemical Analysis. A Laboratory Guide. By W. W. SCOTT, A.M., chief chemist, Baldwin Locomotive works, formerly Professor of Chemistry, Morningside College, New York. D. Van Nostrand Co. 1910. \$1.50 net.

A Course in Qualitative Chemical Analysis. By CHARLES BASKERVILLE, Ph.D., F.C.S., Professor in the Department of Chemistry of the College of the City of New York, and L. J. CURTMAN, Ph.D., Instructor in the Department of Chemistry of the College of the City of New York. The Macmillan Co. \$1.40 net.

We have in these two books further additions to our already long list of works on qualitative analysis.

The first contains a discussion of the ionic hypothesis, the mass law and other physical chemical principles with their applications to qualitative analysis, followed by a systematic study of the detection and separation of bases and acids, methods of analyzing an unknown substance and tables containing special data. The best methods of separation have been selected and a very valuable addition made in the form of notes on each group. In these notes the reasons for the various reactions used and the precautions recommended are discussed, thus enabling the student to work intelligently and not, as is so often the case, merely mechanically. This book can be recommended as an excellent laboratory guide to qualitative analysis, especially if the principles discussed in the theoretical part are applied to the reactions studied.

In the second work special emphasis is placed on the quantitative discrimination of the substances detected by qualitative meth-

ods of analysis as a preparation for quantitative analysis. In selecting methods of analysis those have been preferably chosen which they think can be most readily used by the student; especially if they give rise to precipitation tests which will enable the student to approximate the amounts present. As in the other work, explanatory notes have been introduced.

An objection the reviewer would make to this book is the almost complete absence of any applications of the present theories of solution and the mass law to the reactions of qualitative analysis. Although the statement is made in the preface that these matters are usually presented in lectures in general chemistry and may be taken up in lectures on qualitative analysis, they do not apply these in this book; but retain the molecular reactions and the theory of the formation of complex compounds in place of the methods which are now so generally taught.

J. E. G.

SPECIAL ARTICLES

CHANGES IN CHEMICAL ENERGY DURING THE DEVELOPMENT OF *FUNDULUS HETEROCLITUS*

ALTHOUGH at present it is hardly possible to do more than give a brief report of progress, nevertheless, the results which have been obtained from the calorimetric study of the beginning and end stages in the development of *Fundulus heteroclitus* harmonize so completely with the results gotten by Tangl and Farkas in the case of the chick and silkworm, respectively, that a brief account of the work appears warrantable at this time.

Omitting many details of technique, the methods employed in this study were as follows: The eggs of *Fundulus*, immediately after artificial fertilization, and the larvæ immediately after hatching, were dried at 40° C. This portion of the work was carried on at the Marine Biological Laboratory at Woods Hole, to whose director, Professor Frank R. Lillie, I am indebted for the use of a room. The material, which had been previously carefully counted, was then preserved in the dry state in ordinary phials until used for the chemical

and calorimetric analyses which were carried out in Budapest.

Determinations of the chemical energy—heat combustion—in known quantities of the material were made by means of the bomb calorimeter, strictly according to the rules of modern calorimetry. Small (practically, between 15° and 25° C.) calories were recorded. Concerning the applicability of thermochemical methods to the study of embryogenesis, nothing need be said at present except that indirectly the work of Rubner and others, while directly that of Tangl and his students, can leave no doubt on this point.

Comparison between the fertilized egg and the hatched embryo of *Fundulus* disclosed a discrepancy in chemical energy which can be in no wise interpreted as an analytical error. Thus briefly summarizing the results, it was found that

	Calories
1,000 fertilized eggs of <i>F. heteroclitus</i> contained	3,264
1,000 hatched larvæ of <i>F. heteroclitus</i> contained	2,550
Transformed during development	710

If loss of energy during development is to have any special significance from the standpoint of embryology, it must be shown that no substances rich in chemical energy diffuse out of the egg during the period under discussion. This seems to be true of *Fundulus*, for the nitrogen content of the egg remains constant up to the 240th hour, and probably for the whole developmental period. In the case of the frog also, no substances appear to diffuse out of the egg, for the ash content remains the same from the beginning of the development to the end. The same thing has also been proved for the trout, the chick and the silkworm (Tangl and Farkas). The only alternative therefore seems to be that the discrepancy in chemical energy between the end and beginning stages of development is due to the transformation of chemical energy into heat, or other forms, and not to the diffusion of energy-containing substances out of the egg.

During the developmental period, 384 hours, during which 1,000 eggs of *F. heteroclitus*

lose 710 calories of chemical energy, larvæ are produced whose organic substance weighs in the neighborhood of 0.2 gram. If now the amount of energy lost is divided by the amount of organic substance produced and multiplied by ten, $710/.200 \times 10$, we get 3.6 large (kilogram) calories—an amount which expresses the specific work of development, namely, the amount of chemical energy transformed during the production of one gram of organic substance of *F. heteroclitus*.

The further discussion of these results, as well as of many subordinate questions connected with them, must be reserved for the future, when I shall report upon work of the same kind now in progress on other forms, but not sufficiently advanced to warrant description. The results of Tangl on the chick, however, and of Farkas on the silkworm are highly suggestive, for the specific work of development (Entwicklungsarbeit) of the dry substance (*i. e.*, organic substance + ash) in the case of the former is 3.8 kilogram calories and of the latter 3.1. In consideration of the fact that the errors of observation and analysis are concentrated on these end figures and embodied in them, the almost complete identity of the results for these widely divergent forms,

<i>Fundulus</i>	3.6 ¹ (organic substance)
Chick	3.8 (dry substance)
Silkworm	3.1 (dry substance)

is a strong argument in favor of Tangl's hypothesis expressed two years ago, namely, that the specific work of development (Entwicklungsarbeit) is not a function of phylogenetic position, but the embryogenetic formation of living substances widely divergent in organization seems to be connected with an equal expenditure of chemical energy.

In conclusion, I wish to acknowledge with

¹ Owing to the presence of sea salts in my material, I am unable at this time to calculate the corresponding value for the dry substance of *Fundulus*. Unless the ash diverges very widely from the expected, however, the specific work of development of 1 gr. of dry substance will be in the neighborhood of the value given for the organic substance.

gratitude my great indebtedness to Professor Francis Tangl, director of the Royal Hungarian Institute for Animal Physiology. The unusual generosity with which he placed at my disposal equipment and experience has alone made possible results which otherwise would have been quite beyond my reach.

OTTO C. GLASER

ROYAL HUNGARIAN INSTITUTE
FOR ANIMAL PHYSIOLOGY,
BUDAPEST, November 20, 1911

THE AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE
SECTION F

MEETINGS of Section F were held on Wednesday, December 27, the forenoon session for the reading of papers and the afternoon in joint session with the American Psychological Association. The following officers of the section were elected:

Vice-president and Chairman for next meeting—Professor William A. Loey.

Member of Council—Professor Edwin Linton.

Member of Sectional Committee for five years—Professor A. M. Reese.

Member of General Committee—Professor T. W. Galloway.

The following abstracts of papers have been received by the secretary of the section:

REESE, ALBERT M.: *Effect of Narcotics upon the Development of Hen's Egg.*

The paper is a preliminary account of the effect of certain reagents (alcohol, ether, chloroform, chlorotone and magnesium chloride) upon the development of the hen's egg. Alcohol was fatal in about 75 per cent. of the experiments; ether in about 35 per cent.; chloroform, chlorotone and magnesium chloride were almost universally fatal, though the fatalities in the last two cases were probably largely due to faulty technic.

LINTON, EDWIN: (1) *The Adult Stage of Dermocystis etenolabris* Stafford. (2) *Trematode Sporocysts in an Annelid.* (No abstracts of these papers received.)

ROHRER, C. W. G.: *Observations on the Chestnut-worm.*

The chestnut-worm, or grub, is the larval stage of *Balaninus caryatipes*, one of the Curculionidae or nut-weevils. The "worm" winters in the earth, and issues forth in the spring as a small snout-beetle or weevil. A peck of chestnuts may con-

tain as many as 5,838 worms. One chestnut may contain four or even more. The female, in laying eggs, first bores a hole with her snout through the growing chestnut-burr and into the nut. She then drops an egg into this hole, and pushes it to the bottom of the hole with her snout.

REED, H. D.: *The Occurrence of Dermal Poison Glands in the Nematognathi.* (No abstract received.)

SMITH, HUGH M.: *Notice of a Remarkable New Family of Pediculate Fishes.*

Among the fishes collected by the *Albatross* during the 1907-1910 expedition to the Philippine Islands is a deep-water pediculate from the coast of Celebes, which becomes the type of a new species, genus and family.

ROGERS, BURTON R.: *A New Method of Preserving Anatomical Dissecting Material of Large Animals.* (No abstract received.)

SMITH, MIDDLETON: *The Bowhead.*

Description of the whale; of the primitive implements used in its capture; of the method of killing and "cutting in" as practised by the Eskimo; and of the uses of its products.

CLARK, AUSTIN H.: *A Biological Contribution to the Paleogeography of Australia.*

The old continent of Australia included the present Australia, with New Guinea and the Aru Islands to the north and Tasmania to the south. Timor, Timorlaut, the Ki Islands, Ceram, Gilolo and the islands further west, the islands north of New Guinea, New Britain, New Caledonia, Norfolk Island, New Zealand and the islands further north and east have no relationship whatever with Australia, but form part of more or less marked subdivisions of the East Indian region.

The Australian coast line has subsided since the maturity of the true Australian erinoid fauna; this subsidence has been least on the southeast coast, the degree gradually increasing toward the west and with slightly greater rapidity toward the north; on the west coast there is a similar increase in the degree of submergence from the south to the north. The Australian erinoid fauna of to-day is in the midst of one of those faunal changes called by Cuvier a "cataclysm."

JOHNSON, M. E., and TORREY, H. B.: *Control of Color Differentiation in Frog Tadpoles.*

Experiments have shown that the amount of melanin developed in the skin of frog tadpoles varies with the kind rather than with the quantity of food. Among tadpoles growing at the same

rate, those fed on beef liver produced more melanin than those fed on egg yolk. Egg albumen, beef suet and brown beans resembled beef liver in this respect. These results point directly to the presence of substances in the food that exert a specific influence upon melanin formation. It is well known that tyrosin may be oxidized to melanin in the presence of tyrosinase in various organisms. In the experiments, any possible tyrosinase in the food was inactivated by boiling the latter; and tyrosin was present in excess in the tissues. These facts suggest the presence of an *inhibitor* in the egg yolk, an idea supported by numerous experiments in glass. Tyrosin + tyrosinase + egg yolk (digested or undigested) produce little or no color, while tyrosin + tyrosinase + beef liver (digested or undigested) together produce a marked reaction. That the inhibiting factor may exist in the fat content of the food (i. e., lecithin, cholesterolin) is a possibility now under investigation.

WOODRUFF, L. L.: *Observations on the Origin and Sequence of the Protozoan Fauna of Hay Infusions.*

Data derived from the daily observation, for several months, of the sequence of various types of protozoa in a large number of infusions of hay. Attempt to show that there is a more or less regular sequence. Data also on the source of the protozoa observed in infusion.

MACCURDY, H. M.: *Observations on the Reactions of Asterias forbesii to Light.*

Specimens from six to twelve centimeters in diameter respond definitely and are negative in their reactions to sunlight. The first visible effect of light is a characteristic ventralward movement of the affected rays or ray, accompanied by a retraction of the tube feet. This reflex takes place in specimens either with or without the eye spots. The so-called eyes are drawn inward and the surrounding spines close more or less closely over them in bright light, and the tips of the exposed rays are held low. These reflexes may be local or general. They tend to inhibit or counteract exploratory movements, retard current impulses and induce physiological states and relations which require readjustment. The direction of the new movements is influenced by the retarding effect of light and is determined by impulses from the central nervous system. The tube feet extend readily in shade, and toward the shaded side of a ray. Light retards extension movements. The same is true for the tube feet of *Cribella sanguinolenta* and *Thyone briarius*. It thus appears

that the tube feet as well as the surface of the rays are sensitive to light. The outcome of the reaction is a succession of events usually though not invariably the result of the checking of some movements and the freedom of others. A movement becoming effective functionally induces co-operation in adjacent parts not in that condition. A contact stimulus is functionally stronger than the light stimulus, but is influenced by the latter.

GUDGE, E. W.: *Oral Gestation in the Gaff-topsail Cat-fish, Felichthys felis.*

How the eggs are extruded, fertilized and transferred is not known, but when these processes are effected the male incubates them in his mouth not only until they are hatched by the bursting of the shell, but until the yolk has been absorbed and the young are able to care for themselves. The largest number of eggs taken from the mouth of one male was 55. A cement cast of his mouth had a volume of 580 c.c. The volume of an average-sized egg is 3.75 c.c., of the 55 eggs 206.3 c.c., add 25 per cent. for interstices; total space occupied by the 55 eggs equals 258 c.c. This fish was 22 inches long, and of average size. The eggs average 19-20 mm. in diameter, and the young fish at the end of the period of incubation are 85-100 mm. long. The length of this period can not be stated definitely, since it has been found to be impossible artificially to carry the eggs and embryos to the stage of the free-swimming young. However, it is about 80 days. During all this time the nurse does not seem to feed. The large eggs would, if spawned on sandy or shelly bottoms, be quickly destroyed by crabs and by other fish; if laid on a mud bottom (where the breeding fish are caught) their considerable weight would cause them to sink into and be smothered by the mud. The habit is common to estuarine cat-fish in all tropical and warm temperate regions. These data are based on five summers' work at the Beaufort laboratory of the United States Bureau of Fisheries, in which time scores of male fish carrying eggs and larvæ have been captured and autopsied.

PARKER, G. H.: *The Nervous and Non-nervous Reactions of Actinians.* (No abstract received.)

MAST, S. O.: (1) *The Behavior of Fireflies and its Bearing on Certain Theories of Tropisms.* (2) *Seventeen Different Definitions of the Term Tropism as Applied to Reactions in Organisms.* (No abstract received.)

ESTERLY, C. O.: *The "Oil Fly" of California, Psilopa petrolei.*

The larvæ live in crude oil in incredible numbers. The eggs seem to be deposited outside the oil and the larvæ enter the oil as soon as they hatch. The maggots float in the oil whether it is of the heaviest or lightest specific gravity. All the crude oils observed are lighter than water, but the larvæ sink in water. Even when the animals are motionless in crude oil, they remain on the surface with only the breathing tube visible. If the larvæ are put into such products of petroleum as distillate or kerosene, or such substances as olive oil, they live for from 24 to 48 hours. They do not float in these fluids and it seems likely that the chemical nature of the substances is not the only unfavorable condition. The maggots swarm about the bodies of animals like moths or caterpillars caught in the oil and doubtless feed on them. Yet if the larvæ are kept in oil taken direct from the pump or in that filtered through asbestos, they seem to do equally as well, even to pupating. It seems unlikely that organic particles could be present in such oil, and it is an interesting problem whether the animals can obtain nutriment directly from petroleum. Pupation takes place very readily in the laboratory. The proportion of pupæ formed from larvæ kept in fresh pumped or filtered oil is as large as that in oil taken from pools around tanks or wells. The adults and larvæ do not seem to be phototropic, yet the pupæ have temporary positive phototropism. The paper included a description of larval movements.

MAURICE A. BIGELOW,
Secretary of Section F

THE AMERICAN PHYSIOLOGICAL SOCIETY

THE twenty-fourth annual meeting was held in Baltimore and Washington, December 26-29, 1911. Two business sessions and five scientific sessions were held in Baltimore. Two of the scientific sessions were joint meetings with the Biochemical and the Pharmaceutical Societies.

An unusual number of papers and demonstrations—in all sixty-seven—were presented and discussed, and the sessions were well attended, eighty-six of the society's one hundred and ninety members being present at the meeting.

At the first session in Baltimore President Meltzer made a brief and appropriate reference to the late Professor H. P. Bowditch, one of the founders of the society, at the conclusion of which the members present arose and remained standing for one minute as a token of respect to the memory of Dr. Bowditch. This was followed by the

reading of a memorial address on Professor Bowditch by W. B. Cannon.

The following papers and demonstrations were presented at the Baltimore sessions:

W. W. Osterhaut: The Effect of Anesthetics on Protoplasmic Permeability.

F. S. Lee and A. M. Guenther: Some of the General Physiological Properties of Diaphragm Muscle.

J. Auer: The Action of the Digitalis Group upon the Heart and its Similarity to Cardiac Anaphylaxis.

P. E. Howe (by invitation) and P. B. Hawk: A Comparison of the Data from Two Fasts Each Exceeding One Hundred Days in Length and made upon the same Subject.

J. Erlanger: Observations on the Physiology of Purkinje Tissue.

W. B. Howell: Antithrombin.

W. J. Meek: Relation of the Liver to Fibrinogen Formation.

Th. Hough: The Influence of Different Degrees of Muscular Activity on the Alveolar Tension of Oxygen and Carbon Dioxid.

Y. Henderson: A Brief Report upon the Pikes Peak Expedition.

A. S. Loevenhart: A Contribution to the Theory of the Respiration.

W. T. Porter: The Vaso-motor Nerves of the Heart.

W. T. Porter: Remarks on the Relation of the Phrenic Nerve to the Spinal Respiratory Cells.

T. S. Githens and S. J. Meltzer: The Effect of the Removal of the Heart upon Morphinated Frogs.

T. Sollmann and P. J. Hanzel (by invitation): Post-mortem Absorption by the Lymph Vessels.

Y. Henderson: Some New Respiration Apparatus.

W. Salant: A Modified Langendorff Apparatus for Perfusion of Isolated Heart.

G. W. Fitz: A Perfected Model of the Shadow Pupilometer.

W. T. Porter: An Improved Membrane Manometer.

A. J. Carlson: A Method for Studying the Movements and Tonus of the Empty Digestive Tract by the Means of the X-ray.

C. C. Guthrie: Some New Apparatus.

H. Cushing: The Hemodynamic Action of the Cerebrospinal Fluid.

J. R. Murlin and H. C. Bailey: The Urine of Late Pregnancy and the Puerperium.

C. W. Greene: The Storage of Fat in the Sal-

mon Muscle Tissue and its Resorption during the Migration Fast.

H. C. Bradley: Intestinal Absorption.

J. J. R. Macleod: The Relation of the Suprarenal Gland to Sugar Production by the Liver.

V. C. Myers and G. O. Volovic: Metabolism in Experimental Fever with Special Reference to Creatinine Elimination.

T. B. Osborne and Lafayette B. Mendel: The Rôle of Proteins in Growth.

A. B. Macallum: The Rôle of Surface Tension in the Distribution of Salts in Living Matter.

L. B. Kleiner and S. J. Meltzer: A Comparison of the Effects of Subcutaneous and Intramuscular Injections of Adrenalin upon the Production of Glycosuria.

H. B. Williams, J. A. Riche and Graham Lusk: The Hourly Chemical and Energy Transformations in the Dog which Follow the Ingestion of Meat.

A. Hunter: The Iodine Content of the Thyroid Glands of Sheep Fed Mainly upon Marine Algæ.

E. B. Meigs and L. A. Ryan: The Chemical Constituents of the Ash of Smooth Muscle.

H. Cushing and C. Jacobson: Further Studies on the Relation of the Neurohypophysis to the Assimilation of the Carbohydrates.

D. R. Joseph and S. J. Meltzer: The Effect of Stimulation of the Peripheral End of the Splanchnic Nerves upon the Pupils.

W. E. Garrey: Compression of the Heart Nerves of *Limulus* and the Mechanisms of Heart "Block."

S. Simpson: Some Problems in Hibernation.

D. E. Jackson: A Note on the Pharmacological Action of Vanadium.

C. Brooks: The Blood Pressure of the Normal Unanesthetized Animal under Various Conditions.

W. B. Cannon: The Effects of Stimulation of the Peripheral End of the Splanchnic Nerves.

S. J. Murlin and J. R. Greer: The Relation of Heart Action to Respiratory Metabolism with Determination of Internal and External Respiratory Quotients.

W. G. MacCallum: Further Studies on the Nature of Tetany.

G. W. Fitz: The Principle of the Shadow Pupillometer.

W. P. Lombard: The Pressure in the Small Blood Vessels of the Skin.

C. J. Wiggers: Respiratory and Cardiac Variations in Pulse Pressures.

A. J. Carlson: The Condition of the Digestive Tract in Parathyroid Tetany.

H. Lussky and A. J. Carlson: Further Studies

of the Aceto Nitrile Test for Thyroid Substance in the Blood.

S. A. Matthews: The Effect of Eck's Fistula on the Formation of Bile (dog).

C. Voegtlin and B. M. Bernheim: Further Studies on the Function of the Liver in Various Metabolic Processes.

A. Woelfel: The Place of Fixation or Reconjugation of the Amino Acids in the Body.

J. A. E. Eyster: Electrocardiogram Studies.

E. D. Brown and T. Sollmann: Effect on Blood Pressure Produced by Traction on the Carotid Artery.

E. M. Ewing and H. C. Jackson: A Study of the First Diastolic Rise (c wave) and First Diastolic Fall (x fall) in the Venous Pulse.

J. G. Wilson and F. H. Pike: A Note on the Relation of the Semi-circular Canals to the Motor System.

W. E. Burge: Separation of Pepsin and Rennin by a New Method.

H. H. Hagan and J. K. Armond: The Relation of Calcium to the Cardioinhibitory Function of the Vagus.

E. B. Meigs: Microscopic Studies of Living Smooth Muscle.

S. Simpson: The Curve of Growth in the Dog.

E. L. Ross and P. B. Hawk: Further Studies on the Effects of Etheranesthesia on Metabolism.

F. S. Lee and M. Levine: The Action of Alcohol and Water on Muscle.

J. Auer and S. J. Meltzer: (1) The Respiratory Effect of Electrical Stimulation of the Central End of the Vagus Nerves in Dogs. (2) Inhibition of Respiration by Distention of the Lungs of Dogs under Intratracheal Insufflation.

C. Brooks: The Action of Sodium Citrate on the Circulation.

C. W. Greene: The Absorption of Fat by the Salmon Stomach.

C. W. Greene and Mr. Skaer: The Absorption of Fat by the Mammalian Stomach. (Preliminary communication.)

H. McGuigan and O. Mostrom: Studies on the Convulsive Reflex Produced by Strychnine, (a) Habit, (b) As Modified by Epinephrine.

W. E. Garrey: Temperature Coefficient of Nerve Cells of the Ganglionated Cord of *Limulus* Heart.

The program for the joint session with Section K, American Association for the Advancement of Science, in Washington, consisted of a symposium on Acapnia and Shock. Papers were presented by Y. Henderson, W. H. Howell, G. W. Crile, J.

Erlanger and S. J. Meltzer. The general discussion was participated in by W. T. Porter, J. J. R. Macleod, G. W. Crile, A. J. Carlson, G. T. Kemp and Y. Henderson.

The following persons were elected to membership in the society:

Rockefeller Institute—A. E. Cohn, I. S. Kleiner, F. W. Bancroft.

Johns Hopkins University—L. G. Rowntree, G. H. Whipple, W. E. Burge.

University of Pennsylvania—R. M. Pearce, A. I. Ringer.

University of Syracuse—F. P. Knowlton, C. G. Rogers.

Columbia University—H. A. Stewart.

University of Nebraska—A. E. Guenther.

University of Wisconsin—H. C. Bradley.

University of California—T. C. Burnett.

Western Reserve University—P. W. Cabb.

Starling-Ohio Medical School—R. G. Hoskins.

University of Chicago—A. B. Luckhardt.

The relation of the society to the *American Journal of Physiology* continues as in the past, and A. J. Carlson, W. H. Howell, F. S. Lee, G. Lusk, S. J. Meltzer and W. T. Porter were appointed to constitute the editorial committee for the publication of the *Journal* during 1912.

In the past the annual meeting of the society has occupied three days of the convocation week. But owing to the rapidly increasing number of workers in the society the number of papers submitted for the meetings has already become too great for proper presentation and discussion, in spite of the recent organization of the Biochemical and the Pharmacological Societies. It is generally felt that much of the value of these meetings is lost when time is lacking for adequate discussion of the scientific program. At the second business session this question was considered and the following measures in the way of remedy were proposed and discussed:

1. Extending the time of the meeting to four or more days.
2. Meeting in two or more sections according to subjects.
3. Two or more meetings annually—one in the west and one or more in the east.
4. Limiting the number of papers (each member is at present virtually limited to one communication).
5. Dispense with the formal reading of papers, and devote the time to their discussion on the basis of printed abstract.

6. Changing the time of the meeting to May or June.

7. A closer affiliation with the Biochemical and the Pharmacological Societies.

After a prolonged and earnest discussion the question was referred to the council with instructions to report at the next annual meeting, which will be held in Cleveland, Ohio, in December, 1912.

The following officers were elected for the year 1912:

President—S. J. Meltzer, New York.

Secretary—A. J. Carlson, Chicago.

Treasurer—W. B. Cannon, Boston.

Members of the Council—J. Erlanger, St. Louis, and F. S. Lee, New York.

The arrangements effected by the Baltimore members and friends of the society contributed greatly to the success of the meeting. The headquarters of the three societies were located in the same hotel, and practically all the visiting members were housed in this same hotel. The local members had agreed to dispense with private entertainments, and in their place had arranged for all members and visiting friends an informal dinner followed by a smoker on the evenings of December 27 and 28. By this delightful informality the members were kept together and opportunities afforded for social intercourse and informal conferences and discussions. It was generally felt that this feature should be perpetuated in future meetings.

A. J. CARLSON,
Secretary

UNIVERSITY OF CHICAGO,
January, 1912

THE AMERICAN SOCIETY OF BIOLOGICAL CHEMISTS

THE sixth annual meeting of the American Society of Biological Chemists was held in Baltimore and Washington, December 27–29, 1911. The sessions in Baltimore, held in affiliation with the American Physiological Society and the American Society of Pharmacology and Experimental Therapeutics, in the physiological building of the Johns Hopkins Medical School, were well attended, over forty of the members being present.

The single session in Washington, at the McKinley High School, a joint meeting with the Biological Section of the American Chemical Society, was of exceptional interest from the standpoint of the character of the papers presented and the discussions which they elicited. The following

is a list of the communications which were offered at these meetings:

BALTIMORE, WEDNESDAY, DECEMBER 27, 2:00 P.M.

W. R. Blatherwick, C. P. Sherwin and P. B. Hawk: Intestinal Putrefaction and Bacterial Development accompanying Water Drinking and Fasting.

Amos W. Peters: Essential Conditions of Accuracy and Rapidity for the Determination of Sugar by the Methods of Copper Reduction.

S. R. Benedict: Preparation of Creatine and Creatinine from Urine.

S. R. Benedict: Estimation of Creatinine.

H. S. Raper: The Fate of Fat which Enters the Blood Stream.

H. Gideon Wells: Purines and Purine Enzymes of Tumors.

Fletcher McPhedron: Hemolytic Power of Fatty Acids.

P. A. Shaffer: A New Salt of β -Oxybutyric Acid.

Lawrence T. Fairhall and P. B. Hawk: The Allantoin Output of Man after Water Ingestion.

The following papers were read by title:

E. B. Hart, E. V. McCollum and H. Steenbock: Physiological Effects on Growth and Reproduction of Rations Balanced from Restricted Sources.

E. V. McCollum and J. G. Halpin: Synthesis of Lecithins in the Hen.

E. B. Hart and H. Steenbock: Effect of High Magnesium Intake on Calcium Excretion by Pigs.

E. V. McCollum: Relation between Nitrogen Retention and the Rise of Creatinine Excreted during the Growth of the Pig.

E. V. McCollum: Comparison of the Nutritive Value for Growing Pigs of the Nitrogen from the Oat and Wheat Grains.

E. V. McCollum and E. B. Hart: Experiments on Feeding Dissected Milks.

BALTIMORE, THURSDAY, DECEMBER 28, 9:00 A.M.

(Joint session with the American Physiological Society)

J. R. Murlin and H. C. Bailey: The Urine of Late Pregnancy and the Puerperium.

C. W. Greene: The Storage of Fat in the Salmon Muscle Tissue and its Resorption during the Migration Fast.

H. C. Bradley and H. S. Gasser: Intestinal Absorption.

J. J. R. Macleod: The Relationship of the Suprarenal Glands to Sugar Production by the Liver.

Victor C. Meyers and G. O. Volovic: Metabolism in an Experimental Fever with Special Reference to Creatinine Elimination.

Thomas B. Osborne and Lafayette B. Mendel: The Rôle of Proteins in Growth.

A. B. Macallum: The Rôle of Surface Tension in the Distribution of Salts in Living Matter.

I. S. Kleiner and S. J. Meltzer: A Comparison of the Effects of Subcutaneous and Intravenous Injections of Adrenalin upon the Production of Glycosuria.

H. B. Williams, J. A. Riche and Graham Lusk: The Hourly Chemical and Energy Transformations in the Dog which Follow the Ingestion of Meat.

Andrew Hunter and Sutherland Simpson: The Iodine Content of Thyroid Glands of Sheep Fed Mainly upon Marine Algæ.

Edward B. Meigs and L. A. Ryan: The Chemical Constituents of the Ash of Smooth Muscle.

BALTIMORE, THURSDAY, DECEMBER 28, 2:00 P.M.

H. H. Bunzel: Measurements of Oxidases.

J. R. Murlin and H. I. Muller: Creatine Elimination in the Pregnant Dog.

J. J. R. Macleod, C. D. Christie and J. D. Donaldson: The Estimation of Dextrose in Blood and Urine by the Difference in Reducing Power before and after Yeast Fermentation.

Torald Sollman (for P. J. Hanzlik): Recovery of Alcohol from Animal Tissues.

Otto Folin and F. F. Flanders: A New Method for the Determination of Hippuric Acid (and Benzoic Acid) in Urine.

H. C. Bradley: Synthetic Action of Enzymes.

Paul E. Howe and P. B. Hawk: A Metabolism Study on a Fasting Man.

Paul E. Howe and P. B. Hawk: Hydrogen Ion Concentration of the Feces.

The following papers were read by title:

H. C. Jackson: Changes in the Composition of Blood and Muscle following Double Nephrectomy and Bilateral Ureteral Ligation.

C. C. Benson: Note on the Inorganic Constituents of Human Blood.

P. A. Levene and W. A. Jacobs: On Sphingosin.

P. A. Levene and G. M. Meyer: On Glycolysis.

P. A. Levene and D. D. Van Slyke: On the Pierates of Glycocol.

H. C. Bradley: Connective Tissues of *Limulus*.

C. F. Langworthy and R. D. Milner: The Respiration Calorimeter and its Uses for the Study of Problems of Vegetable Physiology.

H. McGuigan and C. L. von Hess: Glycolysis as Modified by Removal of the Pancreas and by the Addition of Antiseptics.

H. McGuigan: On the Excretion of Formaldehyde, Ammonia and Hexamethylenamine.

A. D. Emmett: Effect of the Quantity of Protein Ingested on the Nutrition of Animals. VI. On the Chemical Composition of the Entire Body of Swine.

O. H. Brown: The Effect of Quinine on Pneumococci.

WASHINGTON, FRIDAY, DECEMBER 29, 2:30 P.M.
(Joint session with the Biological Section of the American Chemical Society)

Thomas B. Osborne and Lafayette B. Mendel: Maintenance and Growth.

Wilder D. Bancroft: The Study of Environment.

Treat B. Johnson: Synthesis of Thiotyrosine.

Alfred Dachnowski: The Relation of Vegetation to the Chemical Nature of Peat Soils.

C. L. Alsberg and O. F. Black: Phytochemical Studies on Hydrocyanic Acid.

Andrew Hunter and M. H. Givens: The Nitrogen Excretion of the Monkey with Special Reference to the Metabolism of Purines.

John H. Long: The Definition of Normal Urine.

W. Koch: Should the Term Protagon be Retained?

H. S. Reed and H. S. Stahl: Oxidizing Enzymes in Certain Fungi Pathogenic for Plants.

William J. Gies: Modified Collodion Membranes for Studies of Diffusion.

M. S. Fine: A Method for Differentiating between Metabolic and Residual Food Nitrogen in the Feces.

E. Monroe Bailey: Biochemical and Bacteriological Studies on the Banana.

The following officers were elected for the year 1912:

President—A. B. Macallum.

Vice-president—Graham Lusk.

Secretary—A. N. Richards.

Treasurer—Walter Jones.

Additional Members of Council—H. P. Armsby, Lafayette B. Mendel, H. Gideon Wells.

Nominating Committee—John J. Abel, F. G. Benedict, H. C. Bradley, Otto Folin, Wm. J. Gies, Andrew Hunter, J. B. Leathes, J. J. R. Macleod, D. D. Van Slyke.

A special committee, consisting of W. Koch (chairman), H. D. Dakin, William J. Gies, J. B. Leathes and Jacques Loeb, was appointed for the

purpose of considering and reporting to the society concerning the nomenclature of the lipoids.

Resolutions were passed by the society concerning the recent deaths of three of its members, Dr. Raymond H. Pond, Dr. Arthur H. Koelker and Professor William F. Koelker.

A. N. RICHARDS,
Secretary

THE MEETINGS OF THE ECONOMIC AND SOCIOLOGICAL SOCIETIES AT WASHINGTON

SEVEN societies met at Washington during the holidays to discuss economic and sociological problems. These societies represent the various fields of economics, civics, home economics, labor, sociology and statistics. Acting under the rule of the council of the American Association for the Advancement of Science adopted at Minneapolis, Section I, devoted to economics and social science, yielded the regular program to the visiting societies with the exception of two sessions, provided by the management governing the correlation of the sections to visiting societies.

One of the notable features of the convocation was the address of Senator Burton, the retiring vice-president of Section I, delivered at a joint session of the American Civic Alliance and of the section at which Dr. J. Pease Norton presided. The address of Senator Burton on the "Causes of the High Prices" has been printed in full in SCIENCE. Senator Burton presented an analysis of the causes which have operated to increase prices and showed conclusively that in addition to the vast increase in the gold supply many individual causes have been operative. The American Economic Association adopted a resolution in favor of an International Commission on the Cost of Living to study the remedies. This was the subject of a round table discussion led by Professor Fisher. Senator Burton's opinion was that natural causes would in a short time produce relief.

At this session the section adopted this resolution:

"Resolved: That the chairman be empowered to appoint a committee whose power and duty shall be to take such steps as shall in its opinion be most effective in focusing the attention of the proper persons and institutions upon the problems of soil erosion and the improved utilization of land through tree crops. This committee to report at the next meeting of the association."

Other addresses were delivered at this meeting

on "Review and Outlook for Banking Reform" as follows:

1. "Requirements of the South in Banking Reform," by William A. Blair, vice-president of the People's National Bank, Winston-Salem, N. C.

2. "The Function of a Gold Reserve in a National Banking System," by Hon. George E. Roberts, Director of the Mint, Washington, D. C.

3. "Relation of Banking Reform to Corporate Financing," by Mr. J. Selwyn Tait, late manager of the International Banking Corporation's Branch, Washington, D. C.

4. "The United States Treasury as Related to the Country's Banking System," by the Hon. Lee McClung, Treasurer of the United States.

5. General discussion of foregoing papers, by Roger W. Babson, formerly expert for the Monetary Commission, Wellesley Hills, Mass.

The Friday evening session of the section, to which the members of the American Economic Association and those of the American Civic Alliance were invited, was one of the largest meetings of the series. Some seven hundred persons listened to addresses on "Corporate Problems of To-day." Dr. John Franklin Crowell, associate editor of the *Wall Street Journal*, was in the chair and opened the session with a brief address. Six speakers summarized the corporate problems of banking and currency, of the railroads and of the industries. The program was:

1. "Problems of Banking and Currency," (a) by the Hon. A. Piatt Andrew, assistant secretary of the Treasury, Washington, D. C.; (b) by the Hon. James T. McCleary, secretary of the American Iron and Steel Institute, New York City.

2. "Problems of Industrial Corporations," (a) by Professor T. N. Carver, of Harvard University, secretary of the American Economic Association; (b) by Hon. John Hays Hammond, Washington, D. C., late special ambassador of the United States to Great Britain.

3. "Problems of Railway Corporations," (a) by John B. Daish, Esq., counselor-at-law, Washington, D. C.; (b) by Samuel Untermyer, Esq., counselor-at-law, New York City.

Each paper presented in succinct form the essential limitations of the problems. If the six addresses were printed together, an excellent handbook of the corporate problems of to-day would be furnished for students of this field.

Much interest was aroused by the address of Mr. John Hays Hammond, relating to the Industrial Corporations, in which he advocated a federal commission. At the close of the meeting, Dr.

Crowell announced the election of Mr. John Hays Hammond to the vice-presidency of the section, succeeding Dr. J. Pease Norton.

Smaller meetings and round table gatherings were held by the visiting societies. The Home Economics Society presented a large and varied program.

The American Economic Association discussed immigration, economic concepts, tariff investigations and the decline of rural population in the south. In the session on tariff legislation Professor H. Parker Willis took issue with Professor Henry C. Emery in regard to the principles underlying the investigations of the Tariff Board and the result was an illuminating discussion fruitful of results.

Dr. John L. Coulter, of the University of Minnesota, and Dr. Frissell, principal of Hampton Institute, spoke on "Rural Conditions in the South."

An important symposium of the American Civic Alliance on the subject of "Old Age Retirement" was participated in by several speakers. Mr. Miles Dawson, actuary of the Armstrong Commission, discussed retirement plans in foreign countries and showed the necessity of the straight pension plan. In this opinion Mr. Dawson was seconded by Mr. M. F. O'Donoghue, president of the United States Civic Service Retirement Association, representing a quarter of a million government employees. An opposite view was taken by Congressman Gillette, who advocated that a portion of each employee's salary or wages be reserved by the government for the use of the employee after his retirement, this fund to be free from attachment and alienation. This plan, sometimes called the "Compulsory Savings Plan," was put forward as the remedy for the situation developed by the large number of superannuated employees in the civil service.

Interesting sessions were held by the statisticians. "The Naturalization of Immigrants" from a statistical standpoint was presented by Mr. Fred C. Croxton, statistician of the U. S. Immigration Commission. Other sessions were devoted to the "Forecasting of Business Conditions by a Study of Statistics" and "Industrial Injuries." The former was treated by Mr. Roger W. Babson, economic engineer, of Wellesley Hills, Mass., and by Dr. John F. Crowell, of the *Wall Street Journal*. The latter was discussed in a joint session of the Statisticians and the American Association for Labor Legislation, led by Charles P. Neill, Commissioner U. S. Bureau of Labor; Frederick L. Hoffman, president of the Statistical

Association; Mr. David Van Shaack, of the Aetna Life Insurance Company, and others. The Association for Labor Legislation also held an important meeting on Friday afternoon on "The Unemployment Problem in America." Secretary Nagel presided.

The only criticism that could be made is that there were too many important meetings held at substantially the same time, so that it was impossible to attend them all. The general result was that one attended that meeting wherein his own personal interest lay, and thus lost the opportunity of hearing and knowing about other subjects, which frequently throw a side light previously unnoticed on one's own ideas and viewpoint.

SEYMOUR C. LOOMIS

SOCIETIES AND ACADEMIES

THE AMERICAN PHILOSOPHICAL SOCIETY

At the meeting of the American Philosophical Society, at Philadelphia, on January 5, 1912, Professor D. W. Johnson, of Harvard University, presented a paper on "The Physical History of the Grand Canyon District."

Few points of geological interest appeal so strongly to the public as the Grand Canyon of the Colorado River. Both in the Canyon itself and in the adjacent plateaus, the geological structure most profoundly affects the scenery. The scenic features may be best appreciated if we know the succession of events in the physical history of the region which are responsible for the present surface forms. This succession was made clear by means of a series of diagrams representing various stages in the development of the district. It was shown that the ancient crystallines of the Granite Gorge, the inclined beds of the Algonkian wedge, and the horizontal strata of the Plateau series, as well as the great erosion surfaces which separate these groups of rocks, have all played a part in determining the character of the Canyon scenery; while the Plateau scenery has been profoundly affected by the north-south folds and fractures, vulcanism and long-continued erosion periods. This relation of geology to topography was shown by colored lantern views of the principal features of the district. On the basis of these views a more detailed analysis of certain events in the geologic history was presented.

THE BOTANICAL SOCIETY OF WASHINGTON

The 77th regular meeting of the society was held at the Cosmos Club, Tuesday, January 9,

1912, at eight o'clock P.M. President W. A. Orton presided. Twenty-six members and ten guests were present. E. O. Wootton and F. D. Farrell were admitted to membership.

The following papers were read:

Botanical Gardens of the East: Lyster H. Dewey.

The author made a trip to Java to attend the International Fiber Congress and Exhibition held at Soerabaya in July, 1911, and visited *en route* the botanical gardens in Gibraltar, Algiers, Penang, Singapore, Buitenzorg, Hongkong and Taihoku, Taiwan (Formosa). After describing these gardens in detail the author stated that they are fulfilling a many-sided mission in attracting tourists, educating even the casual observer as to the identity of plants, indicating the sources of plant products, introducing and distributing plants of economic value and affording research workers exceptional opportunities for study.

Fermentation of Cellulose: K. F. Kellerman, I. G. McBeth and F. M. Scales. (Presented by Mr. Kellerman.)

In the formation and maintenance of humus in agricultural soils the fermentation of cellulose is probably of fundamental importance, yet our knowledge of this question is inadequate. Omeliansky's generally accepted conclusions that cellulose is destroyed only under anaerobic conditions and gives rise either to hydrogen or to methane are erroneous.

Two species of cellulose-destroying and five species of contaminating bacteria were isolated from a culture of Omeliansky's hydrogen organism, and one cellulose-destroying and two contaminating forms from his methane culture; none of the three fermenting species showed any resemblance to Omeliansky's hydrogen or methane ferments. In addition to the species isolated from Omeliansky's cultures eleven other species have been isolated from various other sources; one isolated from manure belongs to the thermophile group.

Contrary to Omeliansky's observation that cellulose-destroying bacteria do not grow upon solid media, most of the species isolated were found to grow readily upon such media as beef agar, gelatin, starch and potato. Some are facultatively anaerobic, but none are strictly anaerobic.

It is usually supposed that filamentous fungi are of little importance in agricultural soils; these investigations show them to be at least as impor-

tant as bacteria in destroying cellulose. About seventy-five species of molds have been isolated, representing a large number of genera; species of *Penicillium*, *Aspergillus* and *Fusarium* are perhaps most numerous.

In the destruction of pure cellulose, either by bacteria or molds in synthetic media, the associative action of organisms which presumably have no cellulose-dissolving enzymes frequently stimulates the growth of the cellulose organism and increases its destructive power.

Some Phases of Microscopical Detection of Decomposition in Food Products: B. J. HOWARD.

W. W. STOCKBERGER,
Corresponding Secretary

THE TORREY BOTANICAL CLUB

THE meeting of November 14, 1911, was held at the American Museum of Natural History at 8:15 P.M., Vice-president Barnhart presiding. Forty-five persons were present.

The minutes of the meetings of October 10 and October 25 were read and approved.

Mrs. N. C. Nuris, 611 W. 177th St., New York City, and Dr. George F. Bovard, University of Southern California, Los Angeles, Cal., were proposed for membership. There being no further business to consider, Mrs. N. C. Nuris was then elected to membership in the club.

The announced scientific program of the evening consisted of a lecture on "Trees of New York City," by Professor C. C. Curtis. The lecture was illustrated by numerous lantern slides.

B. O. DODGE,
Secretary

THE meeting of November 29, 1911, was held in the laboratory of the New York Botanical Garden and was called to order at 3:40 P.M. by the acting secretary in the absence of other officers. The reading of minutes and the transaction of business were passed over and the meeting proceeded with the scientific program. The first announced paper was by Mr. Arlow Burdette Stout on "The Characteristics of the Fungus *Sclerotium rhizodes*, with special reference to its Action on the Cells of its Host," of which the following is an abstract:

Mr. A. B. Stout presented in part the results of his investigations of the fungus *Sclerotium rhizodes* Auersw., a complete report of which will soon appear in a research bulletin of the Wisconsin Agricultural Experiment Station.¹

Special mention was made of the behavior of the fungus in the different organs of the host plant and microscopical preparations were exhibited demonstrating the relations of the fungus to the cells of its principal host *Calamagrostis canadensis*.

The fungus is coexistent in leaves, buds, stems, rhizomes and roots of the infected plants. Filaments of the fungus also form a thin web on the exterior of the roots and extend out into the soil.

In the leaves the fungus is vigorously parasitic. In the culms fungal filaments are most abundant in the region of the nodes, but there is almost no destruction of tissues. In the underground parts of the culms, and in rhizomes the hyphae completely digest the cell contents of cortical cells, but have no effect on the cell walls except at the points of actual penetration. In the older portions of roots the hyphae are scattered through the cortex, where they occupy empty cells. In the younger lateral roots the filaments of the fungus are found penetrating living cells and exhibiting characteristics which have been ascribed to mycorrhizal fungi. Ultimately, however, the cell contents disappear while the fungus remains intact.

The fungus is perennial in the soil, and in the underground portions of the host. It is present in buds, but is unable to penetrate into the growing apex.

The fungus, therefore, exhibits a varying degree of parasitism in the different parts of the host.

The presentation of the second announced paper, "Studies on the Growth and Reproduction of certain Species of *Ascobolus*," by Mr. Bernard O. Dodge, was omitted on account of the illness and absence of Mr. Dodge.

Mrs. N. L. Britton exhibited drawings and microscopic preparations illustrating certain types of thickening in the cell walls of the leaves of mosses.

Dr. N. L. Britton discussed the characters of a new species of *Elæagia* from Cuba. This is a Rubiaceae shrub 8 or 10 feet high, with fruit imperfectly known. The hitherto known species of the genus *Elæagia* occur in the Andes of South America and this new plant from the mountains of Cuba forms another link in the chain of relationship between the flora of the higher altitudes of the West Indies and that of the mountains of South America.

MARSHALL A. HOWE,
Secretary pro tem.

¹ A more complete abstract than is here given appeared in *Phytopathology*, I., 69.